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FACTORS INFLUENCING THE USE OF THE ENVIRONMENT IN SCIENCE TEACHING: A STUDY OF BIOLOGY TEACHING IN TANZANIA.

BY

KALAFUNJA MLANG'A O-SAKI. ©

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
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DOCTOR OF PHILOSOPHY

DEPARTMENT OF SECONDARY EDUCATION
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DEDICATION

This thesis is dedicated to the great forefathers and mothers of Africa, especially Mzee O-saki Materu (~ 1730-1790) for their vision and careful management of our forests, wildlife, mineral and water resources during their time; for mobilizing each other to protect our motherland from selfish destruction, plunder and domination, so that future generations may live and learn to live better.

ABSTRACT

This study explores the forces influencing teachers' attempts to use students' environmental experiences in the teaching of school biology. The focus of the study is form 3 (grade 10) biology classes in a large urban center in Tanzania. It examines questions about conceptions of environmental education (EE), resources available for an EE approach, and professional, socioeconomic, and historical factors influencing classroom processes in three selected school environments.

A social constructionist perspective is used, in which the participants' view of reality (of science teaching, and EE) is perceived as being constantly constructed and reconstructed to suit the world around them. This process of knowledge construction is studied through classroom observations and teacher interviews, and supplemented with responses from a student checklist questionnaire, and School Inspection and other official reports. Interviews were also conducted with a biology curriculum developer and an UNEP environmental education chief. The study then historically analyzes the context in which biology teachers in the study operated, focusing on the barriers to the use of local environmental issues in biology discussions at classroom level.

A number of barriers are discussed in the context of the findings of the study: There are *Professional barriers*, including low level of professional development of teachers, and pressures to perpetuate the status quo of traditional expository teaching. *Language barriers*, whereby the use of the English medium of instruction limits the quality of classroom discussion of local issues, and *socioeconomic barriers*, such as lack of sufficient locally focused teaching materials and low teacher incomes also exist. These affect teacher motivation and commitment to a teaching approach requiring long hours of preparation and thought about student learning activities. Thus, despite numerous past global (U.N. initiated or otherwise) campaigns to promote EE, these barriers influence the construction of any new approach to science education, including an environmental perspective, in the classes studied.

The study concludes that environmental education and other issues approaches in science teaching are unlikely to succeed at classroom level if the notion of curriculum as mere prescription of goals continues to be

perpetuated. Instead, a social constructionist perspective is envisaged in which new curriculum proposals must build in grassroot support systems including collaboratively designed teaching/learning resources, and professional development programs. This implies a strong involvement of classroom teachers in the development of teaching materials. Suggestions for future research to realize these objectives are made.

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Writing a thesis is a long process of construction and reconstruction of arguments, questions, answers, instruments and weighing of evidence. Such a process requires the author to involve a number of people. This thesis owes its shape to the support of many dedicated individuals.

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LIST OF ABBREVIATIONS.

APSP - African Primary Science Project
BAKITA -.Baraza la Kiswahili la Taifa (National Kiswahili (language) Council.
BSCS - Biological Science Curriculum Study (Curriculum Project).
CHAKIWATA - Chama cha Kitaalamu cha Walimu Tanzania (Tanzania Professional Teachers' Association)
CIDA - Canadian International Development Agency.
CSEE - Certificate of Secondary School Examination (O=Ordinary; A=Advanced).
EE - Environmental Education.
EEC - European Economic Community.
FAO - Food and Agricultural Organization (A United Nations NGO).
FINNIDA - Finnish International Development Agency.
HADO- Hifadhi ya Ardhi Dodoma (Dodoma Soil Conservation Project).
IUCN - The International Union of the Conservation of Nature
MOE - Ministry of Education
NEMC - National Environment Management Council.
NGO - Non-Governmental Organization.
NORAD- Norwegian Agency for International Development.
ODA - Overseas Development Agency (U.K).
PSLE - Primary School Leaving Examination
SIDA - Swedish International Development Agency.
SCISP - Schools' Council Integrated Science Program
SMP - School Mathematics Project.
SSP - School Science Project (Of East Africa).
STAURT- Science Teachers' Association of the United Republic of Tanzania.
TANU - Tanganyika African National Union (Political Party for mainland Tanzania up to 1977, now merged with the Afro Shirazi Party to form *Chama Cha Mapinduzi*, CCM translated, Revolutionary Party.)
UNCOD - United Nations Conference on Desertification.
UNDP - United Nations Development Program.
UNEP - United Nations Environment Program.
UNESCO-United Nations Educational, Scientific and Cultural Organization.
UNIDO - United Nations Industrial Development Organization.

UPE -Universal Primary Education.

WCED - World Commission for Environment and Development

WWF - World Wildlife Federation.

Chapter 1

THE CONTEXT OF THE PROBLEM

Introduction

The environment around us supports both our survival as well as our knowledge generation processes. As humans, we depend on a stable environment for our very existence. Through study of the interrelationships among various aspects of our biosphere, we begin to better understand ourselves, our relationships with the environment and how those relationships affect the welfare of the biosphere and ourselves. It is generally accepted that the knowledge of the immediate environment is a crucial prerequisite for any society in its progress in making significant and long lasting scientific and technological developments. In this study, this "immediate environment" is considered in three aspects, which are: the home environment, which includes the biophysical surroundings in which one was born and raised; the school environment, denoting the biophysical setting of the school where one studies, and the regional environment, denoting the biophysical setting of the geographical region in which the country under study belongs. These terms are defined later in the study.

Recent experiences in both developed and developing countries have revealed significant problematic situations when the environment is mistreated or destroyed. This may be done due to both ignorance and poverty as in the development of squatter settlements around cities in the developing world; or in the creation of deserts in such places as the Sahel through overgrazing and shifting cultivation. In the developed world, the search for profits has promoted the use of high technology in clear-cut logging, thereby decimating large areas of forest in North America. The pollution from various industries, ships, and military explosions is threatening all life forms and causing serious disturbances in the biosphere, including the depletion of the Ozone layer. Such experiences have alerted some science educators to seriously reflect on the relevance of the process of generating scientific knowledge to the sustainable development of the environment of the world yielding that knowledge. This is being done in order to try to ensure the long term survival of the human civilizations involved in this process of knowledge generation and application.

Both the living and non-living world and the present human civilization are now under serious threat due to the environmentally detrimental consequences of certain technological developments of the past hundred years.

Science and technology: saviour from poverty, or an environmental explosive?

When discoveries which are considered significant today were made during the last century, humans often viewed them as the savior from suffering, poverty, and most diseases. The steam engine, the car, aeroplane and ship facilitated the movement of goods and people around the world; the developments in microbiology helped humans fight disease-causing microorganisms and make use of beneficial ones in brewing, baking and other processes. Further developments took man to the sea bottom, space, and deep into the lithosphere in search of minerals and other treasures. The desire to harvest and process the maximum possible resources from these environments for improving human standards of living has led to an environmental crisis of serious proportions. The problems of pollution, depletion of the ozone layer, acid rain, the green house (heat trap) effect, the extinction of thousands of species, the threat of a nuclear holocaust, drought, famine, desertification and others are now the most serious threats to the survival of planet earth. In a recent report of the Washington based Worldwatch Institute, Sandra Postell and others summarize the gloomy situation in the following words:

> . . . The looming threats we now face . . . . have so much momentum that unless action begins now to reverse them, they will inevitably lead to paralyzingly costly economic consequences and the collapse of social and economic institutions. (Postell et al., 1989)

The global environmental movement, evolved during the beginning of the crisis, became an outstanding watchdog of the technological revolution in many advanced countries. At the same time, it promoted the need for a cautious approach to technology transfer, calling for a deeper understanding of the inter-relationships in the environment, and hence a sustainable development (as opposed to a mere exploitation) of renewable and non renewable resources, especially in the developing countries of the third world. This call, however, is seldom heeded. The recent war in the Persian Gulf, the pollution it has unleashed into the atmosphere and the sea, and the millions of people it has displaced is a clear example of the a collapse of human institutions described by Postell and others. As was evident during this war, prior knowledge of the consequences didn't deter the parties to chose destruction rather than conservation and patience.

At the global level, the United Nations Organization has made various efforts in mobilizing many countries in this direction. It established UNESCO and UNEP in 1945 to promote educational programs, monitor the problems generated by the improper use of the environment and promote mechanisms geared towards fighting those problems. In 1972, in Stockholm, it was agreed by representatives of many nations that the environment needed attention and that science education should focus more on a better understanding of the environment and the development of positive attitudes towards its protection. Further global UNESCO conferences followed, e.g, Belgrade, 1975; Tbilisi; 1977, and recently, Moscow, 1987. Regional offices of UNESCO and UNEP were established in all continents to promote and monitor efforts of various countries in harmonizing resource consumption and technological development on one hand, with sustainable development on the other.

The African UNESCO Regional Office organized a workshop in Dakar in 1978 to develop its implementation plan following recommendations of the Belgrade Charter and the Tbilisi Conference resolutions. The Dakar Conference offered five suggestions to African states::

1) Design strategies for establishing environmental education programs at the national level;

2) Design strategies for curriculum development and the preparation of teaching -learning materials;

3) Build strategies for the training of teachers in environmental education;

4) Encourage regional/international cooperation; and

5) Build links between formal and non-formal education.

(For a summary of the proceedings of this conference, see Appendix G)

These recommendations were made at a time when most African countries were in a "crisis of identity" (or, as Beeby, 1966, would say, a stage of transition) in science education, when imported curricula, textbooks and even expatriate science teachers, unaware of cultural issues, were unable to work towards the integration of scientific knowledge learned in school with the realities of life in most African societies. To-date, little is known about the actions taken by African governments on any of the five recommendations stated above. First hand reports about African environmental problems are difficult to find within Africa, and one relies mostly on reports from UNESCO, UNEP, FAO and the like, or on reports of non governmental organizations (NGOs) based in Europe (E.g Earthscan, Oxfam, and so forth). These reports take a macro approach and tend to generalize problems in sub-Saharan Africa without considering specific socio-historical and cultural influences working in each specific community. Whittemore (1981), for example, argues as though the problems of land for the very poor were identical between India and most African countries while Garry Knamiller (1987) continues to argue for an "issue-based environmental education in all developing countries" without addressing issues such as the historical role of the "diploma disease" (as described by Ronald Dore, 1975) and the class analysis of the process associated with it, including the strong resistance to "terminal education" being experienced in many African countries. An examination of most UN reports reveals the casting of blame on humanity for environmental crises such as desertification, (UNCOD, 1977), without analyzing the context in educational or socio-economic terms. The same could be said of the report on desertification written for Earthscan (Grainger,1982).

The Tanzanian School System

The Tanzanian school system can be described as belonging to the 7-4-2-3 category. Primary schooling lasts seven years, and is designed to be terminal, implying that only a small percentage of the primary school leavers might proceed with secondary education in the private and public secondary school systems. A debate still continues as to whether the policy of Education for Self Reliance has produced any change in attitudes of school leavers towards community life, self reliance and learning. This will not be addressed in this study, but the interested reader is referred to Malekela (1984), or King (1985).

Those who go on to secondary schools are therefore a small percentage and a relevant science curriculum to enable them to understand the country's environment and its long term role for a sustainable development of its resources is considered crucial for any developing society. It is in this spirit that the policy of Education for Self Reliance (ESR) was developed in the late 1960s. There are four years of junior secondary schooling beginning from age 13 (form 1) to 16 (form 4) when students sit for the Certificate of Secondary Education Examination (CSEE -O level). A limited number of those who perform well can then move on to senior secondary school, i.e. forms 5 and 6, after which, if they pass the CSEE "A" level examination, they can proceed to post-secondary institutions. This study is concerned with form 3 teachers and their students. Little work has been done on the problems associated with teaching science at this level with the exception of the survey studies (Chonjo, 1980; Meena, 1979). These studies were mainly concerned with making inventories of the available resources and manpower for teaching biology and chemistry in forms one to four. According to Beeby (1966, 1980) the Tanzanian Education System, like that of most developing countries, is now in a "Stage of Transition" towards a "Stage of Meaning". In a school system in transition, the enthusiasm of young teachers emerging from the teachers colleges each year is often:

> . . . "lost in the sands of a conservative school system that doesn't understand them." (Beeby, 1980, p. 460).

What is even more important is that the tutors in the teachers colleges may not all be at the stage of meaning. Student teachers may, therefore, not develop a variety of content and methods to cater for individual pupil differences, and other skills necessary to encourage active pupil invilvement in knowledge generation.

Problems specific to Tanzanian secondary school science

A number of problems, including administrative and socio-economic, have made it extremely difficult to achieve the ambitious objectives of the policies, as well as fit into global objectives aimed at introducing environmental education in science teaching. At the secondary school level, the following problems face science teachers in particular:

1. Over-emphasis of content, which is tested by a highly competitive national examination and becomes the greatest motivation for the rote learning of science concepts without understanding or linking them to local science /society issues.

2. Lack of basic science teaching equipment and other resources necessary for promoting practical work in science teaching (Chonjo, 1980; Meena, 1979; Kaino, 1988).

3. Poor professional training and experience (Ishumi, 1984; Chale, 1984; Meena et al., 1987). There seems to be a general lack of skills among science teachers to use locally available resources including the biophysical environment in their teaching. For most diploma teachers, there is also a conceptual problem arising from the low level of classroom interaction they experience in school.

4. An over- emphasis of subject specific science disciplines at all levels, leaving little attempt at integrating or coordinating science education so that it reflects the organization of nature as experienced by the pupils. This problem exists worldwide and is the subject of an intensive debate (Black, 1986; Bohm, 1984; Frey, 1989; Osaki, 1987). In Tanzania, it is exacerbated by making most science subjects compulsory even for the less able and uninterested. For example, according to Education Circular No 4 of 1979, biology and geography are compulsory to all O level students, chemistry and physics must be taken by 70% of all O level students, using the same traditional, academic curricula.

The Historical, Structural and Political Context of Tanzanian Science Education in Tanzania

The educational history of Tanzania, like that of other ex-colonies, is greatly influenced by the former socio- political systems. Three main political systems have influenced Tanzanian society, each carrying with it its own epistemological, educational and philosophical heritage. These include the traditional African heritage, the colonial heritage and the post independence heritage.

Traditional heritage.

The society which now constitutes Tanzania existed for thousands of years as small national ethnic groups, sometimes called tribes. These were culturally distinct, each with its own language, leaders and traditional system of education. The education system was mainly informal, though formal systems did exist in a few communities like the Wachagga, Wahaya, and Wakinga. The environment was rich with diverse wildlife, extensive forests, mountains, lakes and rivers. Hunting, fishing, iron smelting, pottery and farming were the main economic activities. The environment around each society influenced their knowledge generation because every community was self sufficient. Where formal education existed, the curriculum was an extension of what each child did at home with his/her parents, as well as a thorough study of the environment around the community. It was a practical, holistic education, including a core curriculum of family life education, defence and security education, life skills education, social history and so forth (See Lawuo, 1972; Raum, 1940). Informal education included passing on family history, stories, useful plants and animals, and survival skills depending on the way of life within each community, be it fishing, hunting, and so on.

Although scientific theorizing in its modern sense was limited, practical scientific activities produced local technology suitable for the society of the time. There were herbalists, local psychiatrists and the like (named folk psychologists by Westerners), traditional technologists (iron smelters, potters and sculptors) who were specialized members of some communities passing on their skills from generation to generation. There is enough recent archaeological and oral evidence of these activities in various parts of the country and across Southern Africa (e.g Iron smelting in the Usambaras, West lake and Coastal regions dating as far back as 500 years Before Christ (Schmidt, 1978 p. 278). Even after years of western influence, much of this traditional knowledge still exists among the people and is being passed on to the younger generations. According to Horton (1971) many western anthropologists have failed to understand traditional African sciences because few of them understand western philosophy of science, or if they do, they are unable to recognize its African equivalent due to the "difference of idiom" (p. 208). Western educated Africans, however, have recently made many efforts to integrate western and traditional sciences. Traditional medicine, for example, is widely practiced in all parts of Tanzania, and research units now exist at the Faculty of Medicine at the University of Dar es Salaam and other African Universities to study and modernize traditionally used drugs and medical methods. The philosophy behind these "traditional sciences" however, remains different from that of western science which is taught in the schools. First, the role of chance in the occurrence of events is given a special emphasis in documented African Cosmology, asking questions not only of *how* things happen, but also *why* they happen at specific times. Second, unlike the dualistic Cartesian world view, African traditional cosmology is monistic (Odhiambo, 1972 p.44) and embraces a holistic interpretation of events, combining psychological, scientific, and cultural knowledge, closely intertwined in one single thought system (Odhiambo, 1972; Ogunniyi, 1988). Third, since traditional African society was essentially an oral culture, words have also evolved to have great "magical power" and are often used to invoke scientific processes or the service of ancestral spirits; things which are "dismissed contemptuously" by western science (Horton 1971 p. 234). The science curriculum says nothing about African traditional technologies or their philosophies; yet the children sitting in the classrooms live them in their homes. When western forms of medicine, for example, are unavailable or too costly, people turn to their traditional alternatives. When Cartesian science fails to explain phenomena, people in these areas soon resort to traditional cosmologies. This is true all over the third world, from Africa, and Asia to Latin America. The apparent objectives of the colonial administration however, were, among other things, to destroy traditional African society and its culture in order to impose western cosmology and culture and create a demand for western goods.

Colonial heritage

Few would accept the use of the term "heritage" to describe the remains of the colonial system of government found throughout the third world countries because of the sad memories of colonial rule on the lives of the people. This term is used here only to acknowledge the fact that however evil the administration was, its impact on all aspects of life including education cannot be overlooked. Between 1885 and 1961, Tanzania was ruled by Germany (1885-1919) and Britain (1919-1961). Both German and British Colonial rule were designed to either destroy local technology and substitute it with that of the colonial country or use whatever was available to advance further domination and create a climate of dependency as well as a market for the goods made in the colonial country. Western science education was introduced, and made available to a few individuals among the black population. Its goal was to impose western epistemology, and create a demand for western science and technology. By the peak of colonialism many teachers had been imported from the west, as were teaching packages including books and laboratory resources.

There was talk of encouraging knowledge of the environment through nature study, (a program called "education for adaptation", see Lawuo, 1972) but the structure of the whole system was directed by the colonial power, especially during British Colonial administration. All science teaching in middle and secondary schools was in English, a foreign language which the children rarely used outside the classroom. Books designed for the less able western children were used in the colonies; and although "tropical editions" were produced, they could hardly cater for the children of traditional African backgrounds. Books designed for the non-academic stream subjects in Britain, for subjects such as gardening, carpentry, rural studies, and agriculture (Goodson, 1988), were thought to be what the children of the colonies needed. In fact, "education for adaptation" was a series of books designed for Negro slaves in southern U.S.A and adapted to be introduced in African schools in Tanzania and elsewhere. Children of Asian and European descent took an "academic curriculum." As a result, the best students started to hate environmentally oriented subjects, as well as traditional epistemologies. Academic science and the worship of examination success was encouraged, and due to the little relationship between science discussions and the children's life experiences, rote learning was the only route left to most of them. The obsession with "academic standards" measured by western examinations is reflected in the objectives of the 1955 Colonial Secondary Education Syllabus.

> "The child's East African environment and the site of his probable future activities must be the focus. . . ." the syllabus stated, but at the same time
>
> . . . "general academic standards have been carefully observed and at the conclusion of the course the pupil should be qualified to pass the Cambridge Overseas School Certificate Examination or other similar exams." (Tanganyika Government, 1955).

Any curriculum changes were initiated by Britain. Thus, following the post Sputnik curriculum reforms in Britain during the 1960s, selected elite schools in Tanzania, like in most British Colonies, implemented "Enquiry Science" in the form of Nuffield Science, or its local East African version, the School Science Project. There were others such as the African Primary Science Project (APSP), and the School Mathematics Project (SMP) (Yoloye & Bajah, 1980) which were also adopted by schools in the region. During the first years after independence all government schools used the earlier materials, which encouraged rote learning of textbook knowledge without studying local flora and fauna. The new science materials were tried in some Tanzanian secondary schools during the late 1960s. At the time there was a large population of expatriate science teachers who played a large role in the process of curriculum change in the young nation. The process was as difficult for the expatriates as it was for the few local teachers (See Lillis & Lowe, 1987). Olson (1981) and Shipman (1974) describe several problems facing British pioneer teachers in their process of changing teaching styles to accompany the introduction of the Schools Council Integrated Science Project (SCISP) and Keele Integrated Science Project respectively, which were taking place at that time. Change was slow, and biology remained a lecture subject of the classroom with rare laboratory activities or field trips. Links with traditional knowledge were considered irrelevant and unheard of, as modern Africans desired to take the epistemological line of their colonial masters. At the same time, the growth of environmental science from the post war under-achiever's subjects of "Gardening" and "Rural studies" made few teachers, let alone students, want to have anything to do with content which was not academic and, hence, of low status.

Thus, at that time western science was featured as being most important. Local science was not even viewed as science at all, and the new enquiry science was viewed as lacking in rigor in terms of getting students to accumulate scientific facts. As Pendaeli (1986) reports, the enquiry materials were phased out before the mid 1970s and their examinations were abandoned. Teaching remained as an expository style and addressed the objectives of the 1955 curriculum. For the most part, secondary schools were government boarding schools inherited from the colonial era, and were so because,

> . . . the condition under which most students live are hardly conducive to serious study at night" (Tanganyika Government 1955, p. 50).

Only a few city schools, saved for children of colonial government officers and Asian businessmen were day schools. Two of the schools in this study were in the latter category, and the third one was a boys' boarding school. One of the schools had a whole cupboard of SSP and Nuffield materials, prepared in the 1970's to encourage an experimental and environmental approach but had not been used by any of the teachers including those in the study. It seems that the old colonial era teaching style still remains.

Post colonial heritage

Many have argued that since attaining independence, most African countries have made few substantial changes to the education systems of their former colonial administrations (Beeby, 1966; Cooksey, 1986; Mbilinyi, 1979,). In the case of science education in particular, very little has changed. In Tanzania, the system has either stagnated or deteriorated, despite various attempts to re-orient it. Perhaps three phases of the post-colonial era may be distinguished. These include, (a) the period immediately after independence, (1961-1967); (b) The period after the Arusha Declaration (1967-1975); and (c) The period following the declaration of Universal Primary Education in 1977.

(a) The immediate post independent period (1961-1967)

This period was mainly characterized by the continuation of the colonial curriculum philosophy. Most science teachers in the secondary schools were expatriates, and local scientists were very few. In the school which I attended as a form 1 student in 1967, for example, over 80% of the teachers were expatriates, and in the sciences the whole school had only one native science teacher (teaching biology), who was not even a university graduate. Students memorized science textbook definitions, facts and illustrations and were encouraged to stay late at night reading, perhaps to satisfy Locke's view that their minds were *tabula rasa*. The best schools in the country instituted weekly tests to measure how much fluid the sponge was absorbing. During Cambridge Exams, some Tanzanian schools produced the best grades in all the Commonwealth, not in understanding science principles around their environment, or being critical about the ideas in the texts, but in squeezing the filled sponge. The post Sputnik factor had started a debate on the meaning of science in the west, while local Tanzanian leaders had been thinking about the new direction of the independent nation. By 1967, Tanzanian politicians had come to the conclusion that the best policy for the rapid development of the countryside was Socialism and Self Reliance, and that education must prepare the young of the nation to become self reliant.

(b) The post Arusha Declaration period (1967-1977).

The Arusha Declaration and the Policy of Education For Self Reliance (See Nyerere, 1967) emphasized three objectives of education: the production of people with an enquiring mind; development of the ability to learn from others and evaluate new knowledge; and development of the ability to think critically. At about the same time, the enquiry science curriculum movement had gained strength in the west and these curriculum materials were tried experimentally in a number of African countries including Tanzania. This combination of events led many to claim that Tanzania was in for a "revolution by education" (See Resnick, 1968). Biology programs included the Nuffield Biology and School Science Project (SSP) and at the primary school level, the African Primary Science Project (APSP) gained popularity from West to East Africa. The Nuffield and SSP also produced materials in physics and chemistry. The American BSCS materials were also brought in and though they were not officially adopted in any school in Tanzania, they were used by a number of teachers. As stated earlier, the predominantly expatriate teaching staff played a large role in securing teaching materials from the west and in organizing workshops for writing some locally relevant textual materials. Most of them were partly supported by funding generated by the former colonial masters to strengthen the education system in the colonies. By the mid 1970s, many expatriates left due to the great reduction of financial support to Africa following the oil crisis. A number of these former expatriates now work in western universities. As Kenneth King observes, the experience of working in post independent Africa created insight and dedication to African educational issues in many of those who took part. Unfortunately, these teachers never stayed long enough, and when most had left there were too few pioneer local science teachers to continue their work. Perhaps, if they had stayed longer, more could have been learned from them, and they themselves might have better understood both the environment in which they were working and the cultural context of the students they were teaching.

The Tanzanian government, backed by funding from UNESCO and UNICEF, decided to develop its own human resources in all sectors, to replace leaving expatriate staff. It was even announced that the main goal of secondary education was to be self reliant in high level manpower by 1980. UNESCO sponsored a Science Teacher Education Project at the University of Dar es Salaam, which was designed to quickly produce a large number of science teachers for the secondary schools. As Meena et al. (1987) and Nkonoki (1987) have argued, this helped to increase numbers, but the congested curriculum was, perhaps unable to inculcate enough professional expertise in using the local environment, working with the newly developed SSP materials, and abandoning the expository teaching styles that assumed students to be sponges. Moreover, as they went into schools, the new graduate teachers found a status quo which was unaccepting of new teaching styles, an examination system which rewarded the recall of facts, and headmasters who were not in favour of a teaching style allowing students to challenge the authority. This was totally contrary to the philosophy of Education for Self Reliance (ESR) but had been socially constructed within the status quo from practices which seemed to have "worked" during the colonial era, such as the maintenance of teacher authority. Even the emerging socialist government, with its authoritarian models of party supremacy, respect for authority, et cetera were ironically contrary to enquiry teaching and the encouragement of critical thinking. Together, these forces had killed the SSP, Nuffield Science, APSP, and all emerging enquiry curricula in the country. The death of the East African Community (which economically bound together Kenya, Uganda and Tanzania) in the late 1970s destroyed all collegial support within the region. Like turtles, every one retreated into their shells.

(c) The post Universal Primary Education (UPE) era- 1977-1990

In 1977, when UNESCO and UNEP produced the guidelines for EE and associated documents, Tanzania was in a large identity crisis. Science education was facing several problems such as few qualified teachers, expansion of private secondary schools, and resignations of frustrated and underpaid teachers from government secondary schools to take positions in private schools. The latter, though better paying, had poor teaching facilities and a student population perceived to be academically weak (those failing the Standard 7 selection examination). At the same time (early 1970s) the government tried to start a School Equipment Development Unit (SEDU) but it did not get started, and a donation provided for its development was returned to its source. This was due to problems described by Pendaeli (1985) as" problems of under-development." They include a lack of commitment by the government to implement its own policies, inefficient approaches to problem solving, and the frustration of the able expertise. At the same time national interest had shifted to Universal Primary Education (UPE) and adult education. In 1977, UPE was declared in Tanzania, and most government resources were directed to a distant teacher education program aimed at supplying the large number of primary schools with enough teachers. There were many problems with this bare foot approach to UPE; further details may be obtained from Ishumi (1984); Omari & Mosha (1984); and Malekela (1985). Thus, interest in environmental issues in the school curriculum never went beyond the ministry files. Most SSP, Nuffield and BSCS materials remained locked in school cupboards.

The impact of economic factors on science education.

A number of socioeconomic factors have been responsible for the low performance of education and other sectors in Tanzania since independence in 1961. They have affected the education sector in several aspects, including the production of science graduates (including teachers), and teacher incomes and motivation.

The production of science graduates and science teachers

Since the oil crisis of the early 1970s, the growth of all the social sectors in the Tanzanian system has stagnated. The nation maintained only one university until 1984, when an agricultural university was opened at the former Faculty of Agriculture and Forestry of the University of Dar es Salaam in Morogoro. Even then, there was no significant growth in the number of science graduates, including science teachers, to serve the growing numbers of secondary school students in private and government secondary schools. Table 1 shows the growth of university enrollment and graduates, and Table 2, secondary school enrollment. The subject of Biology is compulsory to all students in junior secondary school, and so requires a large number of teachers.

Table 1: Output of science graduates at the University of Dar es Salaam, 1965-1988

Year	B.Sc Ed	B.Sc Gen	B.Sc Geol	B.Sc Hydr	Tot.Enr	Tot.Grad
1965-66	-	-	-	-	40	-
1969-70	274	41	-	-	315	16
1970-71	303	65	-	-	368	70
1971-72	275	112	-	18	387	80
1973-74	319	186	-	33	538	110
1974-75	342	160	19	51	372	130
1975-76	309	120	27	48	504	175
1976-77	297	78	49	36	462	170
1977-78	241	94	42	15	392	172
1978-79	248	73	57	-	378	105
1979-80	259	103	56	-	418	135
1980-81	249	96	54	-	399	100
1981-82	215	258	53	-	526	105
1982-83	182	175	49	-	406	146
1983-84	153	191	49	-	393	127
1984-85	202	182	47	-	431	112
1985-86	300	145	54	-	499	110
1986-87	325	120	52	-	497	N/A
1987-88	272	84	47	-	403	N/A
1988-89	237	73	31	-	341	N/A

Source: Ministry of Education Statistics, 1988 and University of Dar es Salaam Admission File, 1989.

Table 2: Secondary School Enrollment 1980-1988.

Year	**Public Schools**		**Private Schools**		
	No. schools	Enrollment	No. schools	Enrollment	ENR. TOTAL
1982	N/A	38982	N/A	30162	69144
1983	85	39737	85	31219	70956
1984	85	40617	85	33519	74136
1985	86	40323	107	40775	81098
1986	95	43911	193	45703	89614
1987	103	45821	142	58225	104046
1988	N/A	50584	N/A	68258	118842

Source: Ministry of Education Statistics, 1988.

Secondly, relative government spending on education since the mid 1970s has greatly declined. (See Table 3).

Table 3: Government expenditure on education, health and defence (1972 and 1986).

Year	**% of total expenditure**		
	Education	Health	Defence
1972	17.2	7.2	11.9
1986	7.2	4.9	13.9

Source: Adapted from: Heyneman, S.P, (1989). Economic crisis and the quality of education. *International Journal of Education*, 10 (2/3), pp. 115-129.

The impact of low teacher income

Teachers earnings for the last 20 years were considerably lower compared to other sectors (see table 4). There was little incentive for experienced teachers to stay on in the profession, because salaries and conditions of service actually worsened with increasing experience. As described in the current findings, one teacher resigned from teaching during this study and another was looking for a better paying job elsewhere. The average earnings of graduate teachers as compared with that of other graduates is portrayed in a recent study by Galabawa, (1989) as indicated on Tables 4 and 5.

Table 4 Average earnings of university graduates by degree programs and years of experience. (Tanzanian Shillings.[1])

Years Experience	B.A Ed	B.A Gen	B.Sc.Ed	B.ScGen	LL.B.	BS.Eng	B.SAgr	M.D
1-2	28800	28589	22800	29307	34554	39493	----	42000
3-4	28264	36591	33091	32801	29050	32991	26688	---
5-6	33910	29618	35829	28839	30744	37287	33020	27000
7-8	33626	35400	28303	37918	38089	53247	29515	45000
9-10	47580	33265	35386	41887	50256	40127	32562	37908
11-12	42029	40930	39111	---	38858	47650	36432	44540
13-14	43733	47403	33293	---	72000	---	---	44040
15-16	41696	41512	35412	---	--	---	---	---
17-18	40333	46424	42572	---	---	---	---	---
19 & >	46322	---	---	---	---	63144	---	---

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Galabawa, J.C (1989). *Cost benefit analysis of private returns to university schooling.* Ph.D dissertation, University of Alberta. (Table 6.3, p.105).

The disrupted pattern of benefits by years of experiences in certain cases is explained by the existence of mature students in the sample, whose experience before the degree was not an important determinant of their earnings after graduation (See Galabawa, 1989, p. 114).

Table 5: Annual Benefits by Degree Programs and Years of Experience (In Tanzanian Shs [1]1989).

Years Experience	B.A Ed.	B.A Gen	B.Sc.Ed	B.ScGen	LL.B.	BS.Eng	B.SAgr	M.D
1-2	28800	28589	22800	29307	26991	29700	17110	11900
3-4	28264	31513	27620	27715	29050	32991	26688	15433
5-6	28469	29618	35829	28839	30774	37287	33020	27000
7-8	33628	35400	28303	37918	38089	36978	31046	45000
9-10	47580	33265	35386	41887	50256	40127	32562	37908
11-12	42029	40930	39111	63075	45688	47650	36432	44540
13-14	43733	47403	33293	70767	72000	75694	68997	44040
15-16	41696	50000	45264	78459	81250	85218	90354	80513
17-18	47000	46424	48575	86152	90343	94742	118621	111095
19+>	55083	95319	76090	93844	99844	104266	156032	153741

Source: Reproduced with permission from:

Galabawa, J.C (1989). *Cost benefit analysis of private returns to university schooling* . Ph.D dissertation, University of Alberta. (Table 6.4 p.109)

[1] One U.S $ = ~T.Sh. 195.00 (1990)
= ~ T.Sh 64.26 (1987)
= ~ T.Sh 17.47 (1985)
= ~ T.Sh 08.28 (1980).

(Source: United Republic of Tanzania, Ministry of Finance Statistics, 1988 and Budget speeches, 1988 & 1989)

The role of the environment in teaching/ learning processes has rarely been studied qualitatively in any secondary school setting in Africa so far. The efforts of UNESCO/UNEP and the other global organizations have produced elaborate goals and objectives aimed at encouraging a holistic environmental approach to science teaching. The Dakar Conference resolutions for Africa (UNESCO, 1978), especially recommendations 2 and 3, stressed this need. The objectives of teaching science subjects all point to the need to .."know ourselves and our environment..." (Biology syllabus, form 1 to 6), including our forests, seas and oceans, and the like; ..."reflect the importance of agriculture to the country's economy..." (Chemistry syllabus, form 1-4); and yet the knowledge of the issues in these aspects of local environment is relatively low (O-saki, 1983). There is a need to study factors/conditions influencing the success or failure of schools in using the total environment as a basis for science teaching and hence promoting its better understanding and management, to pave the way for the development of locally focused teaching materials. This study might provide a better framework for understanding the problems of implementing an environmental approach in science education, and the role of the teacher in the teaching/learning process. The teaching of environmental issues or any other science/technology and societal issues must reflect the factors influencing decision making in those issues. Aikenhead (1980 p.42) identifies a number of such factors, including, economic, political (including, military, legal), technological, scientific, and cultural (including religious, ethical, fine arts). Cultural issues, especially in third world context, are also dealt with in Vulliamy (1985), and Jegede et al. (1989).

Summary

In this chapter, the contexts of the environment are given as the world around our home, school or region. Aspects of the historical development of environmental education in global and Tanzanian contexts are described, as well as the historical, structural and political forces influencing science education in general. The goal of introducing environmental issues into the science curriculum is faced with many problems, some of which are global, while some may be specific to Tanzania. This exploratory study will describe and analyze barriers to the development of locally focused teaching materials and the management of relevant professional development programs. It will also discuss possible passages through such barriers. The rest of this thesis is organized as follows: Chapter 2 discusses theoretical foundations and other contexts of the research, Chapter three provides a review of the relevant literature, while Chapter 4 describes the methodology and design of the study. In Chapter 5 the findings of the study are described, while Chapter 6 attempts an interpretation of the findings, focusing on the conceptions of EE held at various levels of the curriculum implementation hierarchy and the historical development of these conceptions and their incorporation in the curriculum. Finally, Chapter 7 concludes the thesis by presenting a summary of the study and some implications of the findings for the teaching and learning of biology in Tanzania.

Chapter 2

THEORETICAL FOUNDATIONS AND RESEARCH CONCERNS

School science and environmental problems

The relationship between school science and science in the world around the child has been a subject of considerable research and speculation. This has led to attempts at developing school science programs considered more relevant to the problems and issues facing the world. From the environmental point of view, school science is expected to promote more caring attitudes towards the natural environment, rather than the mere understanding of its components and their potential for more technological development (since the 1972 U.N. conference on the Human environment and subsequent appeals from UNESCO/UNEP). An abundance of research has been conducted probing the knowledge, beliefs and attitudes of students towards environmental issues, and the development and evaluation of environmental education (EE) programs, especially in the United States, Europe and Australia (See reviews by Roth, 1976; Iozzi, 1981; Lucas, 1980; Dissinger, 1985). Most of these studies revealed that while attitudes, measured by Likert scales, could be positive, students' knowledge of the crucial environmental issues and the understanding of possible alternatives remained low (Thomson & Gasteiger, 1985). Secondly, positive attitudes did not correlate with positive behavior (Kothandapani, 1977; Lucas, 1980-81). As research work continues in this area, it is becoming increasingly clear that other factors, especially economic and social, have a much greater impact on environmental education and the prospects for action than it was once thought. At the theoretical level, environmental thinking has evolved from its original emphasis on aesthetic principles, to "preservation", "conservation", "protection", and recently, sustainable development of resources.

Tanzania and other African countries are faced with the problem of economic under-development, characterized by the lack of modern technology and suffering caused by disease, poverty and ignorance. Thus the primary concern of most people in these countries is not focused on how the environment can be protected for the future, but rather, on how it can be used now to improve socioeconomic development and the material standard of living. This might partly explain the lack of extensive research on knowledge, beliefs and attitudes in environmental issues, and the lack of the existence of a strong environmental movement in such countries.

Epistemological considerations

From an epistemological viewpoint, school science must encourage a better understanding of the world around us. Among the philosophers of science, Lakatos (1972) has argued that as humans establish a "core" of scientific knowledge about the world, they develop a research program to investigate the certainty of that knowledge. Using Lakatos' analysis on our knowledge of the process of learning science, Gilbert & Swift (1988) identify two recent research programs which have addressed this process.

The Piagetian research program focuses on a hierarchical development of knowledge about the environment by increasing an understanding of the behavior and logical relationship of its various parts. (Inhelder & Piaget, 1958; Shayer & Adey, 1979; Adey, 1987 a&b). To Piagetians, observations and the collection of information from the environment is the basis of understanding the relationships among various schemata, and the possible use of this understanding as an interpretive framework on which to anchor new learning by assimilation into existing schemas, or by a rearrangement of existing schemata in order to accommodate new ones.

The Humanistic research program, on the other hand, focuses on the child's construction (and reconstruction) of theories (Claxton (1984) calls them "minitheories") about observed events. This construction is used to examine the replication of these minitheories in future observations and to strengthen the child's growing world-view (Kelly, 1955). In a Kuhnian sense, these minitheories develop into "paradigms" or strongly held beliefs, which may be difficult to change, and may require a process of "revolution," in the child's world-view. Humanistic psychologists sometimes compare children's learning of new concepts to the revolutionary change of thinking known to have occurred in the history of scientific thinking (Lawson, 1988). The assumption both here and in the Piagetian view seems to be that the environment plays an important role in the construction (and reconstruction) of scientific knowledge. As children grow and interact with their environment, in the presence of adults and peers, they acquire viewpoints attempting to make sense of various environmental phenomena. Some of these viewpoints are naive and incorrect, or unacceptable to contemporary scientific thinking, and have been called "alternative conceptions", "intuitive ideas","misconceptions", et cetera (Solomon, 1983; Driver, Guesne & Tiberghien, 1985; Driver & Bell, 1986; Pfundt and Duit, 1985). The science classroom, where attempts are made to present modern scientific explanations, is therefore a place where many students can experience much cognitive conflict. The classroom interaction process can also introduce new wrong conceptions (Ola -Adeniyi, 1985), or fail to enable children to break through their alternative conceptions, or relate abstract concepts to their daily life experiences in their environment. This can be most serious when the concepts being taught are divorced from past and present experiences of the students in their local environment. In many African countries, where science education was introduced from a western perspective, this cognitive conflict is increased in three main ways.

1) The teaching of science, especially at the secondary school level, is in a foreign language used only in the classroom and hence not the appropriate medium for effective interaction, the sharing of previous learning experiences, or the correction of conceptions unacceptable to contemporary scientific thinking.

2) Most curriculum materials have been produced outside the continent, and reflect in many ways, a cultural conflict with African values and knowledge generating processes. For example, while science education usually approaches problems from a cause and effect mode, much of "traditional thinking" (used here in the sense used by Ogunniyi, 1988) also tends to look for anthropomorphic explanations to events. Questions asked include not only what causes events and how they occur, but also, "why at particular times", thus questioning issues of probability (Yoloye & Bajah, 1981; Yoloye, 1985). Recently it has been suggested that most science textbooks in Africa now need to be re-written in order to focus more on the local scientific and social issues facing African societies, and to address the epistemological question of promoting "a symbiosis between traditional world view and scientific world views" (Ogunniyi, 1986; 1988). This task requires a synthesis

of the research on local aspects of the biophysical environment as well as a thorough understanding of the teaching/learning process.

3) Subject specific curricula from early years of secondary schooling have tended to encourage the compartmentalization of many students' understanding of both scientific knowledge and the natural environment. They have propagated the notion that scientific knowledge (now broken down into physical, biological, earth science and so forth) and the environment (often broken down into physical, natural, human-made, socio-cultural, psychological, et cetera.) are equal to, rather than greater than the sum of their parts.

The Education for Self Reliance (E.S.R) challenge

Despite the three problems of the secondary school curriculum mentioned above, teaching continues as usual in the schools, as though everything was going smoothly. Apart from the critical comments of Mbilinyi (1979), which describe Tanzania secondary teaching as a "copy-copy exercise" in most schools, research work on classroom processes in Tanzania remains weak. So, too, is work towards an understanding of the role of a child's life experience and natural environment in developing science concepts. The political philosophy of Education for Self Reliance which guides educational practice in Tanzania (Nyerere, 1967, TANU, 1974) also emphasizes that science teaching must enable children to develop a critical understanding of their local environment and generate solutions to local problems. In practice this includes learning about: 1) things which can help them understand the environment in which they live; 2) the manner in which they can use the resources in their environment to improve standards of life over the long term; and, 3) how they can use their environmental heritage to increase productivity through hard work. Most schools, therefore, have economic projects ranging from grain farms, retail shops, and livestock keeping, intended to enable students to produce as they learn, and appreciate that "Education means work" (TANU, Musoma Resolutions, 1974). The success of this approach is questioned by various authors examining the integration of education and community development in many third world countries (Bacchus, 1982; Saunders & Vulliamy, 1983). Given the multitude of social and economic problems facing the third world, easy solutions are difficult to generate without a thorough knowledge of the historical, structural and political factors at work and the socioeconomic context in which they operate.

A Theoretical Framework for the Study

The limits of Cartesian positivism

An attempt by science educators to develop a theoretical framework in EE research has yet to generate a concensus. Researchers in the area, anxious to design alternative educational strategies to those based on dominant western traditions, are now faced with a problem of reorientation. A recent attempt by Aho (1988) reflects this crisis. Aho tries to invoke "cognitive, socio-emotional and ethical arguments" to justify environmental ethics and ultimately ends up suggesting a framework which involves "socio-emotional states as they relate to the cognitive understanding of the man / nature relationship" (p. 188). This line of argument is still unpursued, and the ethical issues she mentions touch the very foundations of western thinking which seem so strong at the moment, and so attractive as the road to modernity and prosperity.

The rationality which drives the present western scientific tradition took many years to develop, and was propounded by the 18th-century philosopher, Rene Decartes, following Bacon's earlier idea that knowledge gained through science should be put to work. Decartes assumed a separate and independent realm of mind and matter, encouraging the belief that reality was "out there" and separate from the knower. Thus knowledge was conceived as a means by which humans assume power over the material world. This assumption, separating material knowledge from human values, was the basis for the growth of the industrial revolution and scientific materialism, and is the dominant paradigm of western thinking. According to Rees (1988):

> Westerners see the external world, the biosphere, mainly as a warehouse to be plundered in satisfaction of the material "needs" and "wants " of humankind. (quotes added) (p. 275).

Hence, reductionist science remains their only acceptable analytic mode. As for the environment, this thinking reduces it to:

> . . . individual resources, or, at best, as a mechanical construction whose component parts are bendable to human will and purpose (p. 275).

This desire to "manage individual resources" is reflected in the organization of government departments into fisheries, forests, lands, water, energy mines, and so forth with little regard to independent properties of the whole (Bohm, 1980; 1984). All countries which have been ruled by western colonial powers were forced to take this model in their formation of government structures, and abandon their previous models, which were, from the western point of view, "primitive and prescientific." In economics, this concept is reflected in the principle of exponential economic growth (Developed in Adam Smiths' neoclassical economics).

The current illusion that recycling of resources will ensure a steady economic growth is a product of this kind of thinking. It is overshadowed by the facts inherent in the Second Law of Thermodynamics, namely that since the world is a closed system, available matter and energy are continuously and irrevocably degraded to the unavailable state (Georgescu- Roegen, 1977). Thus, the assumptions underlying Cartesian scientific rationality and neoclassical economic growth paradigm are, therefore, untenable today.

As Rees concludes,

> This (Cartesian) world view, however successful when the industrial world was young, is a dangerously shallow perception of present reality. The accelerating decline of the biosphere is evidence that many of its basic assumptions are simply wrong,

and thus long term sustainable development in the light of current patterns of resource consumption is:

> . . .not even theoretically conceivable (p. 277).

From Rees' rather radical point of view, it seems ironic to see the Eastern Block, which, for over 40 years has defended economic planning and controlled resource consumption, now desiring to join the "free market economies." If the East Europeans and Asians are serious, given their large populations, then the last nail to the coffin of the world as we know it will soon be put in place.

Similarly, the building of this economic-growth-as-a-solution paradigm into the 1987 United Nations' World Commission on Environment and Development report, rather than encourage a reduction of consumption in developed countries and promote a sharing of the existing resources in the developing countries, makes it not reflect on its title "Our Common Future", but rather, "Our Common Demise." Thus, rather than accept these assumptions, this study will use a humanistic perspective, as developed in, "constructive alternativism", (Kelly, 1955) "social constructionism" (Schutz, 1932, Berger and Luckman, 1967, Goodson, 1989), and "personal knowledge" (Polanyi, 1958).

Constructive alternativism

This study is guided by a constructivist view of human learning. This view asserts that reality is "constructed" by individuals through their interaction with nature and other humans around them. The constructivist position originated in psychology from the work of Kelly (1955), but philosophically, it stems from the "verstehen" tradition of Alfred Schutz and Max Weber. According to Kelly, individuals, in their own personal way, often assume the stature of scientists, and seek to predict and control the course of events with which they are involved. They look at the world through transparent patterns or templates which they create and then:

> . . . attempt to fit over the realities of which the world is composed. The fit is not always very good. Yet with such patterns the world appears to be such an undifferentiated homogeneity that man is unable to make any sense out of it. Even a poor fit is more helpful to him than nothing at all (Kelly, 1955, pp. 8-9).

These world patterns, called constructs, are the processes individuals use to construe the world. They are similar to Kuhn's paradigms, except that unlike the latter, personal constructs are not backed by the organized, communalistic, disinterested and shared universality as they are in scientific paradigms. Polanyi (1958) makes a similar argument when he says that knowledge can not be separated from the knower, and that a persons' knowledge of the whole depends on their creation of a meaningful integration of subsidiary clues, developed from social interactions as well as interactions with the biophysical environment. Polanyi calls these two interactions the "noosphere".

In the context of the environment, the problems that form the major threat to life today (extinction, pollution, ozone depletion, the greenhouse effect, erosion, desertification, and so forth.) are constructs developed in the minds of most people since childhood, either with perceived solutions or temporarily embedded in previous constructs which attempt to make sense of other global ecological phenomena. According to constructivism, learning is an attempt to confirm, modify or change existing constructs in the light of new experiences. Claxton (1984) describes learning as the "modification of minitheories" in the light of new personal evidence. Good teaching only amplifies this process of the "reconstruction" of past personal experiences.

Thus a teacher will be viewed as a helper to each individual child as the latter struggles to test and modify his/her previous constructs. One role of teaching materials is to increase the rate of this construct modification, and those designing new materials must build in experiences, in the form of learning activities, which can stimulate learners to: 1) examine their existing constructs on each topic; 2) test them by using scientific procedures available to them to see if they are scientifically verifiable and are working in the long term interests of the survival of the universe; and, 3) reflect on alternative procedures of critically testing their present conceptions in the biophysical environment. The checklist of activities in the student questionnaire used in the present study has been designed with this theoretical framework in mind. So, too, is the interview schedule for the teachers, curriculum developers and others. Such an approach is taken in order to determine if the interaction of these individuals with nature and each other is leading to "learning" in terms of modifying their previous thoughts and behavior.

To understand how teachers operate in their classroom situation, Alfred Schutz's notion of social construction of reality will be used. Schutz (1932) views social constructionism as "interaction and interpretation of a stream of experience to form a stock of knowledge." The position taken is the one advanced by Berger & Luckman (1967) and Goodson, (1989) which recognizes that meanings are socially articulated and shared but have origins in the concrete lives of individuals. I found this approach attractive in exploring teachers' work in class, and in my interviews on their past experiences as biology teachers in various school environments. The "historical conditions" are important here because Tanzania is a developing country which has been under centuries of tribal rule up to the 1880s. Then came Arab and Islamic influences, followed by German colonial rule (1880s - 1919), and British rule (1919 - 1961). At present, post independent nationalist rule (1961-), characterized by dependency on former colonial rulers and other western states directs science, technology and its associated education. The influence of the nation's history on the thinking and lifestyles of people is something one cannot ignore and hence, it would be unrealistic to be ahistorical. It is in the light of this background that a biology teacher who wants to use the environmental approach operates. What are his/her conceptions? How do they function ? What professional support is available, and what forces are at play in the teaching-learning milieu? These are some of the issues investigated in this study.

Social constructionism

The origin of social constructionism can be traced back to the concerns of early educators on the relationship between theory and practice. As early as 1904, Dewey stressed that professional instruction of teachers is not exclusively theoretical but involves a certain amount of practical work, and that improvement of education includes not only turning out teachers who could:

> . . . do the things that are now necessary to do, but rather by changing the conception of what constitutes education. . . . (Dewey, 1904, p. 338).

Schwab attacked the reliance on theories outside education (theories of ethics, knowledge, politics,sociology, learning, mind, personality) in developing educational materials. He argued that most of these theories were "ill fitted and inappropriate to the problems of actual teaching and learning" (Schwab,1978, p. 287).

Some educators still maintain that *curriculum theory* guides *curriculum research* and enables new teaching materials to be generated and used as various forms of knowledge (Hirst 1969), realms of meaning (Phenix, 1964) or content structures learned through discovery (Bruner, 1971). None of these curriculum theorists, however has developed a theory of curriculum which is independent of the theories of learning, knowledge, politics, mind, personality or society. Thus any curriculum theory existing today suffers Schwab's criticism of inappropriateness to the problems of teaching and learning. The reliance on theory to guide practice has, therefore, produced few successes in implementing prescribed curriculum goals. According to Goodson (1989), setting goals has proved to be a futile exercise because "scoring (those) goals is difficult" and, "the goal posts are not always relevant" (p. 4). This practice also creates a class of educators, (mainly scholars) who are expected to set and police the goals, and another, (mainly classroom teachers) who are expected to score the goals. The two groups often fail to work as a team, and end up talking past each other. Social constructionism developed from the work of Schutz who argued that reality develops from direct experience followed by subsequent reflection and comparison of notes. It was later influenced by Mead's ideas of the "self" and "generalized other", the notion of symbolic interactionism (Blumer, 1967), and the view that reality is "socially constructed" (Berger and Luckman), (1967). The use of the Social Constructionist perspective in curriculum research owes its pesent shape to the extensive research of Goodson, (1988, 1989). Similar approaches in curriculum research include "Curriculum Evaluation as Illumination" (Parlett and Hamilton, 1972), Dilemmas of Curriculum Inquiry, (Olson, 1981); and "Inside a Curriculum Project" (Shipman, 1974). The major goal of these studies was to understand the *context* of curriculum decision making at the levels of prescription, process and classroom practice. The emphasis was on teachers personal interpretation of the goals of curriculum projects and their implementation in classroom situations. According to Goodson (1989), social constructionism involves 3 levels of direct experience of curriculum interpretation:

1) The individual life history level;
2) The group or professional level, e.g. the development of subject disciplines, classroom stability/change, evolution of "acceptance practice", et cetera.
3) Relational level-changing relations between groups, collectivities, and individuals, as for example, between teachers, teachers and curriculum developers/administrators, educators and other professionals, such as lawyers, scientists, environmentalists, historians and so forth.

Either one or any combination of the above levels of interpretation can be used. Underneath the observed direct experiences is a great influence of social and economic history.

Personal knowledge

A theory of personal knowledge was advanced by Polanyi (1958), and relates the process of social construction to personal experience. To Polanyi, knowledge cannot be separated from the knower. This view also joins those which argue that knowledge (of science, pedagogy, or theory) is linked with the life histories of those who generated it.

PURPOSE OF THE STUDY

This study aims at understanding the factors influencing the process of the teacher/student interaction in generating biological knowledge from the environment. The context of the study is Tanzanian secondary school (form 3 or grade 10) biology classes. The focus is on factors influencing teachers' interpretation and teaching of the biology syllabus in the context of their school environment and the policy guidelines of UNESCO/UNEP.

GUIDING QUESTIONS

The study attempts to answer the following questions:

(1) a) What conceptions of "environmental education" are held by UNESCO/UNEP officials, one of the curriculum developers, and form 3 biology teachers?
  b) What aspects of the local environment (home, school or region) do form 3 students study in their biology classes?
(2) What teaching materials and resource personnel are available to biology teachers to facilitate an environmental approach in their teaching?

(3)a) What is the impact of socio-economic, political or cultural factors on the use of the environmental approach in biology teaching in the schools?
  b) Are there school factors, (e.g. location, administration of the school etc.) which facilitate or inhibit teacher/student involvement in environmental issues?

(4) What teaching strategies and learning activities are used in order to make the teaching/learning of biology relevant to local, national and global environmental contexts?

SIGNIFICANCE OF THE STUDY

This is an exploratory study. It aims at exploring classroom practices as they relate to curriculum intentions, the facilities available in schools which support classroom implementation of global environmental policies, and the factors influencing attempts to use the environment in the generation of scientific knowledge. It will be of significance to educators, students, and national/global policy makers (UNESCO/UNEP and curriculum developers particularly) in providing an indication on how their efforts are being received at the grassroots level in Tanzania.

LIMITATIONS

This is an exploratory study of translating curriculum policy into practice in a selected number of schools.

1) The findings reflect the situation in the schools and of the teachers studied. Any generalizations to other schools or teachers will have to be made with caution.
2) The scope is limited to the biology form 3 classroom only. The situation in other science subjects and classes will not be explored.
3) No detailed analysis of the curriculum policy formulation process will be made. The objectives explored will be those of secondary school biology teaching, form 3 (grade 10). Other grade levels will not be examined.
4) The study will not evaluate student performance on environmental concepts as stated in either the UNESCO objectives or the biology syllabus.

ASSUMPTIONS

This study is based on the belief that the environment can be used as a means of generating new scientific knowledge in a constructivist manner. The use of the qualitative approach, mainly a social constructivist approach, (Berger & Luckman, 1967) is evident. The main aim is to uncover deeper challenges facing the teacher who tries this method of teaching in the Tanzanian school setting. Four assumptions underlie this study, including:

1) The environment supports all life in the biosphere. It must be developed and maintained so as to sustain life now and in the future (UNESCO, 1980).

2) The environment is also the source of most of our scientific knowledge, which we acquire by the process of formulating and modifying our understanding through personal participation and:

> . . . the creation of a meaningful integration of subsidiary clues dwelt in as a projection towards the achievement of a focally known whole. (Michael Polanyi, quoted in Prosch, 1986, p. 135).

3. The process of planning and teaching of science courses is influenced by teaching materials (texts, educational media and other support) and resource personnel available, as well as the biophysical environment of each school.

4. Understanding of the teaching learning process requires the interpretation of teachers' "lived experience" (Schutz, 1932) and constructing their reality in the context of existing historical and cultural conditions.

DEFINITION OF TERMS

The key terms used in this study are defined as follows:

Biology syllabus refers to the Tanzanian biology syllabus currently in use at the secondary school level (Ministry of Education, 1976, see Appendix H), including any associated circulars or guidelines which have been issued to supplement the original document, such as sample unit plans.

Biophysical environment refers to the combined natural (biotic and abiotic) and man made aspects of the surroundings.

Environment (implies biophysical environment) refers to the combined natural and man made aspects of the surroundings in which one lives. In this study, we shall distinguish the surroundings of the home as the *home-environment*, those of the school as the *school environment*, and the interrelationships within the region (in this case, the Eastern and Southern Africa zone) as the *regional environment*. Any interrelationships which extend beyond such environments will be related to the *global environment*.

Environmental action refers to any activity done by a group or individual for the purpose of preventing the deterioration of an ecosystem due to human or other agencies. A school class may take environmental action to clean an ignored market place, (or launch a protest, or lobby at the people responsible to clean it), plant trees in a region threatened by desertification or soil erosion, etc.

Environmental approach is a teaching-learning style that utilizes the environment in the development of scientific principles.

Environmental education is used here in the sense used by Lucas (1979). It includes education *about* the environment, (i.e cognitive understanding including the development of skills necessary for this understanding); education *for* the environment (directed towards developing attitudes to sustainable development of natural resources); and education *in (or from)* the environment, (characterized by techniques of instruction concerned with using the world outside the classroom in the generation of scientific concepts). I also include the critical examination of local knowledge and belief systems about environmental issues.

Environmental science is an integrated method of learning scientific concepts through collecting, processing, analyzing and evaluating information concerning the biophysical environment.

Interpretation is a formative process in which meanings are used and revised as instruments for the guidance and formation of action. (Schutz, 1932, Blumer, 1969). Classroom teachers' interpretation of the syllabus in the context of their local environment forms a focus in this study.

Teaching resources include sources of information such as textbooks, teaching media; expertise, (technical personnel such as technicians, and ecological experts,) or physical facilities such as classrooms, laboratories, green houses, etc.

UNEP refers to the United Nations' Environment Program. It works in collaboration with UNESCO in the promotion of environmental education. Its global Headquarters are in Nairobi Kenya.

UNESCO refers to the United Nations' Educational, Scientific and Cultural Organization. The Head office is in Paris, and the Africa Regional Headquarters are in Nairobi, Kenya. Each country which is a member of UNESCO has a National UNESCO Commission; this includes Tanzania and most African countries.

UNESCO/UNEP guidelines refer to the global recommendations of the 1977 UNESCO conference held in Tbilisi, Russia (UNESCO, 1980) and the African plan of action developed at Dakar, Senegal (UNESCO, 1978).

Chapter 3

REVIEW OF THE LITERATURE

Introduction

This chapter presents a review of the literature on environmental education and the factors influencing its teaching within science education. The purpose of the chapter is to present a global perspective of the milieu of environmental education, and describe the research which addresses the factors which influence attempts to introduce the approach into African countries.

The interdisciplinary nature of the subject of environmental education has introduced a variety of semantic problems that are evident in the literature. Writers in the area use different terms to refer to goals of environmental education. In his review of the conceptual status up to 1980, Lucas (1980) recognized three conceptual areas linking science education and the biophysical environment. One area is concerned with education *about* (or on) the environment, thus emphasizing the promotion of cognitive understanding, including the development of skills that are necessary for this understanding (Linke, 1980). Then there is education *for* the environment, directed toward environmental preservation or improvement for particular purposes (most writers now prefer the term sustainable environmental development to environmental preservation). This focus has been characteristic of local and global 'environmental groups' (mainly activist organizations) and can also be found in the goals of UNESCO, UNEP, the World Wildlife Fund (WWF), the International Union of the Conservation of Nature (IUCN) and other organizations seeking to promote action to reduce the rate of environmental deterioration (Lucas, 1979, and UNESCO, 1972, 1976, 1980, 1983, 1987). Thirdly there is education *in* (or from) the environment, characterized by specific techniques of instruction that utilize the biophysical environment or social experiences outside the classroom, as in *Using the environment* 1974, the British Science 5-13 teaching books (among many other curriculum innovations of this nature) which emphasized learning by using the school environment as a resource. However, despite such distinctions, many writers still use the contexts of Environmental Education (EE) interchangeably, reflecting the concern expressed by Dissinger (1985) that the definition problem is far from over.

The subject of "environment"

The historical dimension

The subject of " caring for the environment" has origins that date far back to the 19th century nature conservation movement. The evidence available suggests that concern about the deterioration of the environment began with expansionist agriculture and industrialization in Western Europe. The destruction of the natural beauty of the countryside was the first concern, hence the early nature conservation drive was for aesthetic reasons, and was mainly an appeal of the upper classes for the preservation of natural beauty, probably as a form of natural art. As time passed more of the countryside was taken up by developers, industrialists, and a conservation movement was born, emphasizing the reduction of further development lest the trees and other vegetation should all be replaced by buildings and other human made structures which changed or destroyed the natural beauty of the countryside. Many farmers, interested in more production and increased income, have been resistant to such preservation which prevents them from farming more land or acquiring larger grazing areas. Fishing companies, likewise, have a tendency to want to harvest the seas indiscriminately and often beyond their country's "Exclusion Zones" because of their naive belief that the resources of the seas and their ability to act as sinks for human wastes are "unlimited". They overlook the fact the seas are, in fact, global commons and require international cooperation in their development and management. For these groups, G. Hardin (1972) warned of the "Tragedy of the Commons", arguing that it was in every one's interest to restrict their freedom to overgraze or overfarm because the consequences of their actions would bring ruin to themselves and every one else in the commons. To address this concern, the concept of sustainable development was introduced in the global environmental literature in the late 1980's. Sustainable development is defined as:

> the use of existing resources for the needs of the present without compromising the ability of future generations to meet their own needs (World Commission for Environment and Development, WCED, 1989, p. 8).

The increased industrialization in the world and its associated problems of pollution and energy depletion has led to further warning of an impending environmental crisis. At the center of condemnation is the unequal use of global resources between more developed and less developed countries. The former, which are highly industrialized, use the largest proportion of global resources, and contribute the largest environmental damage (pollution of the land,sea and air, the threat of war and so forth). The latter, which are poor, densely populated and less industrialized, are faced with problems such as hunger, desertification, deforestation, et cetera. Moreover, by copying the methods of the developed nations they are brewing larger volumes of pollutants in an already polluted world. While many concerned individuals think hard to resolve these issues, new industries, with serious environmental consequences, continue to be promoted. The thrust of the condemnation now is to greedy industrialists, whose desire to extract the maximum pasture from the commons for private profit is now viewed as the most dangerous element in the sustainable development movement.

Goodson (1987) has used life history as well as subject history approaches to review the emergence of environmental education as a school subject in the British Education System from the time it was a "low status subject" called *gardening*, to the time it was labelled *"environmental studies"* .The history reveals a number of issues about the struggle by environmentalists to have environmental education recognized as a discipline deserving a place in the school curriculum. First, gardening developed as an activity in secondary schools after the Second World War, designed to teach children from lower class families some skills of tending gardens, growing vegetables and flowers. It was not on the school timetable but existed as an "extracurricular activity." After a long struggle of gardening teachers for academic recognition , the name of the subject was changed to *Rural Studies* and was included in the timetables of secondary modern schools. "Secondary moderns" were schools for the academically weak, who failed the selection (11+) examination allowing them to join the prestigious grammar schools, which were introduced after the 1944 British Education Act. After changing the name of the subject to "Rural Studies", the teachers also won a place in school staff rooms where they could mix with their colleagues.

> . . . even if he has to kick off muddy gum boots to drink his cup of tea. (Goodson, 1987, p. 92).

Rural studies continued to be offered in emerging comprehensive schools after 1965, especially in those schools which had a secondary modern history. The appointment of headmasters with grammar school background, however led a decline of the subject due to omission of the facilities for the subject by school heads who had:

> ". . . little or no experience of the value of rural studies in the education of the secondary child." (NRSA report, 1967; quoted in Goodson, 1987).

Due to the practical nature of the content, examining boards were reluctant to set "O" and "A" level exams in rural studies, viewing it as unacademic, unexaminable, and hence, of low status. Thus, in spite of the change of name, the old concept of the subject as predominantly gardening for the backward children only, did not die easily. As it will be shown later, this attitude towards the subject was spread in the prestige schools of then British colonies, including Tanganyika. The growth of naturalist organizations (of which there were 450 in Britain alone by 1958) and the formation of the Conservation Society in 1966 had started to persuade people to .."live within the renewable resources of the earth and not beyond its limit." The Natural Environment Council Report of 1965-6 (HMSO, 1967) stated that the countryside and its wildlife was highly vulnerable to the impact of human pressures of many kinds, including the needs of agriculture, industry, urban development, and recreation.

Similar developments were taking place elsewhere. In the U.S. an emphasis on conserving human resources found its place in the Educational Policies Commission of the National Education Association in 1935. It was insisted that:

> . . . since future welfare and safety depends on these things (conservation of resources for the common good), the schools may well assume the considerable responsibility for checking the ravages upon the heritage of the nation made by indifference, carelessness and unbridled (sic) selfishness. (Quoted in Hamm & Adams, 1989).

These developments in the larger society gave a boost to environmental education in the school curriculum. Rural studies teachers united into a subject association and the subject was renamed Environmental Studies. With the backing of the Council of Nature and the Conservation Society they started teaching issues such as conservation and pollution. Within subject specific disciplines, especially geography and biology, there were those who encouraged the integration of rural studies teachers and hence strengthen the emerging environmental studies subject. There were others, especially those in prestigious schools, who remained in their subject specific disciplines, and looked down upon the generalists who taught environmental studies as "not rigorous enough." This historical background indicates how environmental studies was born out of gardening and rural studies, merging with geography and biology.

The status of environmental studies, given this background, never went beyond "pious proclamations"- few of the predominantly grammar school educated teachers felt fit to share the label with secondary modern failures who once taught gardening. The Cartesian empiricist conception of science prevailed, with the brightest students being taught better ways of "conquering nature" and developing more technology. Following the launching of Sputnik in 1957, science was even more compartmentalized, where the subject disciplines were further supported in order to produce purer scientists who could develop superior technology which could catch up and be superior to that of the communist block. Even in the British colonies, the rising ruling classes tended to aspire for a more powerful alliance with the high status members of their rulers, hence preferring Oxford, Cambridge and such high status institutions, which had little to do with environmental studies, and more with biology, chemistry, geography and other specific disciplines. For example, attempts to introduce carpentry and agriculture in the schools in Tanganyika during the 1960s met strong resentment from both parents and school children who had begun to aspire to be scholars in the classic theoretical sense (Cameron & Dodd, 1970). A period of "academic education " ensued until 1967 when Julius Nyerere introduced Education for Self Reliance as the main focus for all curricula. At first the reception appeared enthusiastic but the tension between academic orientation and utilitarian objectives remains (Cooksey, 1986). Thus, environmental education innovations remained only in elementary schools, and mainly supported by foreign organizations (For example, the Polytechnic Education Support PESP, supported by a German organization in Tanga; the death of the Kwamsisi Community education program is discussed by Pendaeli, 1985).

The role of global organizations: The United Nations Organization.

Since the birth of the United Nations in 1945, the discussion of global issues affecting all humans has increased as experts realized the futility of individual country action on matters of environmental concern. Conferences have characterized the main activities of U.N. bodies, as illustrated by the activities of UNESCO and UNEP since 1949. These activities are summarized below.

1949- A United Nations' Scientific Conference on the Conservation and utilization of Resources was held, and later during the year, UNESCO sponsored the foundation of the International Union of the Conservation of Nature (IUCN). A series of conferences /programs were initiated.

1961- UNESCO set up a specialized Ecology and Conservation Center.- World Wildlife Federation (WWF) was born.

1968- At the UNESCO Biosphere Conference, an educational program designed to "develop EE study material for educational curricula at all levels, stimulate Technical Training, and stimulate global awareness in environmental problems" was proposed.

1970- First European Conference on Conservation of Nature and Natural Resources was held. The main concern was Pollution in an overcrowded Europe. Edward Heath, in a "Countryside in 1970" Conference emphasized ". . . protecting our lovely countryside and our glorious coast. . . ." as the highest priorities of the seventies."

1970- International Working Meeting in EE in Nevada, U.S. laid emphasis on appreciation of interrelationships (man, culture and physical surroundings).

1971- Zurich conference of European specialists on EE-desired to develop an awareness program and Environmental specialists to fight Environmental degradation. The main issues focused on whether EE should be incorporated within subject areas or taught separately. Some argued for the reform of educational systems. Others emphasized a mixture of approaches, including separate courses called Environmental Studies or separate study of issues within traditional disciplines such as sciences, geography etc. It was proposed that emphasis during teaching should be on: fieldwork, first hand investigation and open discussion of problems.

1972- Conference on the Human Environment was held in Stockholm, Sweden. This was more "action oriented" mainly because the problem of pollution of the land, air and sea was growing bigger and beyond the effort of single countries to tackle. Barry Commoner argued for the survival of all human groups on the "only one earth," while Malthusian and neo-Darwinian theorists pressed for the survival of the fittest in the human species.

1975- UNESCO-UNEP meeting held at Belgrade, Yugoslavia, drew up guiding principles, goals and objectives for EE at the global level. The resulting document became popularly known as "the Belgrade Charter", and encouraged improvement of all ecological relationships, including the inter-relationship of humanity with nature and with each other. This would be achieved through creating an awareness of the issues, imparting knowledge, attitudes, skills and the ability to evaluate and participate in environmentally sensitive problems.

1977- An intergovernmental conference on strategies for Environmental Education was held at Tbilisi, Russia. It recommended actions at all levels (national, regional, and international) involving strategies and guiding principles for EE in school curricula. These ranged from the holistic consideration of natural, technological, social, moral, aesthetic and cultural-historical aspects of human life in all formal and non formal educational programs, to the examination of specific local issues at separate subject, or integrated subject level.

1982-3- Willy Brandt's Commission produced the document: North- South: A Common Crisis. Some issues addressed in this volume included:

1) Poverty and hunger in the 'south' should concern the 'north' since it will accelerate the rate of environmental degradation;

2) A new international economic order is required, for example, in introducing equal terms of trade between north and south and,

3) Common solution to the problems of the environment, war technology, energy, and hunger should be sought.

1987- UNESCO-UNEP Conference: World Commission on Environment and Development (WCED): Our Common Future: led by Norwegian Prime Minister Gro Harlem Bruntland, was held in Moscow, USSR. About 300 specialists from over 100 countries were assembled. Among the issues discussed included: (1) The needs and priorities since the 1977 Conference and a review of the action taken by UNESCO since 1977; (2) A strategy for action in the 1990's was drawn up, focusing on the fight against desertification, extinction of flora and fauna species, pollution, depletion of the ozone layer, poverty, and nuclear accidents. Guidelines were given to all to countries and experts on (1) research and experimentation; (2) educational programmes and personnel training; (3) technical and vocational education; (4) educating and informing the "public"; (5) "university" and "specialist" EE and, (6) international and regional cooperation. WCED defined the concept of "sustainable development" as:

> development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

This was to replace the old concepts of "Environmental preservation", "environmental protection", and "environmental conservation", which tended to emphasize the enclosure of environmental facilities, and prevention of their further use by humans.

(For further details on UNESCO-UNEP plans, see UNESCO-UNEP, 1976, 1977, 1980, 1985 & WCED, 1987)

EE Research: Response to U.N. Initiatives

The U.N. Conference in Stockholm in 1972 stimulated research into various aspects of environmental education. The argument about the tragedy of the commons, propounded earlier by Garrat Hardin, had warned that if the world was considered as a common pasture, and all humans as herdsmen, the tendency by herdsmen to think they are maximizing their gain by keeping more animals would eventually lead to a serious loss of pasture and then soil deterioration, affecting all the human race. "This is the tragedy", Hardin noted, ..."freedom in a commons brings ruins to all." (Hardin, 1968, p. 162). The global call was for an environmental education for all herdsmen (and women) and their children. Researchers, seeing this need, responded generously.

The research literature that ensued following the Stockholm Conference was massive, especially in the United States, Europe and Australia, where pastures were at their greatest risk. From the reviews of Roth (1976); Lucas (1980); Iozzi (1981) and Dissinger, (1985), three major thrusts may be identified, each using a variety of methods:

1) Surveys of existing knowledge, beliefs and attitudes, in students and teachers

This research direction was, perhaps, the most dominant in the 1970s, especially following the recommendations of Stockholm Conference. Iozzi (1981) identifies a total of 392 such studies between 1971 and 1980. Many more have been done between 1980 and now. Many researchers believed that after assessing the current knowledge of school children, teachers, and the public in general, they would understand the educational needs of the system, and determine the basis for developing new curricula and global or national campaigns. A number of methods were used, but the main ones included surveys, descriptive case studies, correlational studies and even theoretical speculations. In surveys, knowledge was measured in free response or multiple choice questions (as in Eyers, 1975; Richmond & Morgan, 1977), while attitudes were determined using standard instruments designed on the Likert 5 point scale philosophy. (Moore, 1981. Thomson and Gasteiger (1985) for example, used the Likert scale in a questionnaire to study student's attitudes and changes with respect to environmental issues within a 10 year period, between 1971 to 1981. It included their personal rating on the willingness to give up certain items that have impact on lifestyle and resource use, or environmental degradation. The findings indicated a growing individualism and reluctance to give up lifestyle for the sake of the environment during that period.

Not every one is satisfied with the Likert type attitude scale. As an instrument, the Likert scale has been criticized on a number of grounds. It gives little guidance to the understanding of viewpoints of respondents. In a recent assessment, Aikenhead (1988) found that students picking "agree" or "disagree" on a particular statement may have different reasons for doing so, and so the same response doesn't necessarily mean the same thing for two different respondents. Aikenhead concluded:

> . . . the Likert type responses offer only a guess at student beliefs, and the chances of an evaluator guessing accurately are very remote. . . . (p. 615)

Likert scales were designed to make quantitative comparisons of attitudes (Likert, 1932). The best Likert scale is one with a large number of monotone items which will be able to countercheck the belief of the individual and detect a random checking of responses. Few of the scales used in EE research have satisfied this criterion. Some earlier survey studies, however, combined surveys with teacher interviews. Jacknicke, (1968), for example investigated the extent to which teachers use local resources in the teaching of biology. He found that most teachers were making very limited use of readily available local organisms, but his study did not explore reasons leading to this limited use of the locally abundant organisms.

The view that EE should be designed to develop attitudes (implying education for the environment) has been advocated by many researchers in the area (Stapp 1970); Linke 1980). The measurement of attitudes to evaluate the 'success' of environmental education is not only impossible, given the low reliability of the instruments used (Roth, 1976) but also meaningless due to the inability of the measured attitudes to predict behavior and action which can be taken in order to produce desired environmental conditions. The use of attitudes by many curriculum guides and research studies to evaluate the effectiveness of the materials remains therefore, questionable; for there is no evidence that knowledge generates attitudes, nor that attitudes generate desired behavior and promote the desire for action as claimed by some researchers in this area, (Southern, 1971).

2. The development and trial of new curriculum materials

This research direction has also been expanding a great deal, producing materials ranging from purely integrated science programmes (e.g Schools Council Integrated Science Programme-SCISP) to those which are closer to the separate science programmes, but with an environmental flavor (for example, Environmental biology, geography, chemistry or physics courses). In between are programmes that are integrated and environmental biased, e.g. Project "Teaching Activities in EE" (Wheatley 1973). The development of these materials was done by analyzing objectives from policy documents (Ronfeldt, 1969) or on workshop settings with groups of teachers, (e.g. Roth, 1970). Sometimes surveys of students' existing concepts were done by their teachers using questionnaires and tests (Allman, 1972, Eyers 1975).

The process of developing EE curriculum materials has involved the design of teaching/learning materials, followed by the experimental testing of them through the use of pretest- treatment-post test studies. A variety of experimental studies have been conducted, ranging from studying students' learning of specific concepts to evaluating the effectiveness of curriculum materials at formative or summative levels. Among the studies in this area, include testing the ability to learn specific concepts such as 'biodegradation agent' using pretest-post test research designs (e.g. Arganian, 1972, Boone, 1972). As is the practice with most experimental techniques, a number of standardized instruments were designed. Roth (1976) has listed 36 such instruments for the period 1973-76, while, more recently, Iozzi (1981) has listed 45, developed between 1971-1980. Many more have since been developed. The desire was to have as valid and reliable a measure of knowledge and attitudes as possible. The need to reduce the gap between what is being taught and what is written in the curriculum blueprints was addressed by Sparks (1977). Sparks developed and field tested a guidebook for solid waste education (an 8-10 week programme). He suggested that EE should either be developed as independent integrated curricula, or integrated within traditional disciplines, or as an integration of existing concepts into transdisciplinary or interdisciplinary programmes, focusing on local, narrow definitions of environmentalism. He suggested the use of widely experienced experts in the process of designing materials, in order to maintain its multidisciplinary or problem solving characteristic.

Other experimental studies include those of Brady (1972), Howie (1974) and many others. Brady, for example, exposed a group of students to EE concepts through fieldtrips and compared their performance with another group exposed to the same concepts through TV and other media. He found a significant difference beyond 0.01 level in pre-post test comparisons. Similarly Howie oompared outdoor and indoor classroom experience, and found that classroom experience produced better results in concept formation. A comparison of instructional methods (Hosley 1974) was also done using a standard instrument, called Cartel's Sixteen Personality Factors. Broadly speaking, experimental studies in this area have led to the following findings:

1. Fieldtrips, media and outdoor activities are useful in enhancing learners' attitudes;
2. The classroom setting is useful in forming initial concepts;
3. Outdoor activities provide appropriate concepts for conservation;
4. The multidisciplinary approach is quite appropriate and at a little cost to create awareness; and
5. Teacher oriented and student oriented EE strategies exist.

Design of Simulation games

A few studies have focused on the design and testing of simulation games in teaching environmental education. Sibley (1974) compared the effectiveness of a simulation exercise, and conventional instruction in teaching ecology and population concepts at elementary and junior high school levels using a standard instrument, the Environmental Attitude Inventory. There was an increase in positive attitudes in students who used simulation games.

Studies on the impact of EE Curricula

Studies monitoring the impact of curricula or global campaigns on society and the general environment, and the obstacles (epistemological, cultural or social) restricting access to educational messages were the recommendations of the Tbilisi EE conference in 1977. They took various forms. Development of action plans were carried out as in experimental studies , involving small scale trials of developed programmes, followed by larger scale trials. The European Community Action Plan, for example, was formulated a year before the Tbilisi Conference, in 1976, and strengthened thereafter. Pilot schools were set up and programmes were tried in these schools, slowly diffusing into others, through teacher/pupil exchange visits, teacher seminars, production of materials, newsletters, et cetera. The next phase included relating EE to the economic problems of the European Economic Community such as pollution, acid rain, nuclear waste, et cetera (Trant,1984). Sheldon, (1973) used the pre/post test techniques and questionnaires to study environmental action in Iowa using a variety of standardized instruments such as The Environmental Management Concept List, Tennessee Self Concept Scale, Inventory on Social Issues, and Test on Understanding Science. It was found that environmental action campaigns had a higher success rate with students from high socio-economic background and led to positive growth in self concept.

Thies (1974) studied the administration of EE courses in 16 western states of the U.S.A. through a participant observation method. After the study, Thies recommended the integration of EE with field experiences into all teacher education program courses, a revision of curriculum and methodology in camp programs, and the use of interdisciplinary curricula. Ulrich (1974) used a questionnaire to ascertain the degree with which selected populations agree on the value of EE objectives and their use in public schools. It was found that EE objectives were being utilized only 25% of the time. Other methods, used less extensively, include the photographing of facilities available for EE, e.g flowers, animals, scenes etc. (Cherem, 1972). Interpretation of environmental information has been studied using qualitative methods such as observations and interviews, as in the study on the interpretation of the environment in parks, (Field & Wagar,1973) and observation and tape recording of conversation around museum exhibits (Lucas, McManus and Thomas, 1986). This new direction into understanding the process of personal construction of scientific ideas from the environment surrounding learners may well be the direction of the 1990s. Such studies will enlighten both environmental educators and epistemologists interested in the process of construction of science concepts from the environment, the possible sources of 'misconceptions' and the skills required by teachers to tackle these misconceptions. Also to be studied will be a reconceptualization of new curriculum initiatives which will address the problem of behavior and viable action, and, perhaps, the design and evaluation of adult education programmes targeted towards decision makers, business investors, and others whose decisions so greatly affect the environment we live in. Ways must be sought to educate these people, who, in spite of all available evidence, continue to argue in terms of 'saving money at all costs' rather than in maintaining a sustainable environment.

Research into factors influencing environmental education

Work into factors influencing the teaching and learning of environmental education remains limited. The historical approach of Goodson (1987), and Goodson & Ball, 1985) have revealed how the "subject status" bandwagon has influenced the retention of environmental issues in academic, subject specific disciplines. The emerging academic journals, reflecting the thinking in university departments, seem to reflect this trend. Biology departments formerly compartmentalized into departments of botany, zoology, bacteriology and so forth, have, in recent years, seen the emergence of several new environmental disciplines including: environmental marine biology, conservation biology, environmental entomology, geology, engineering, satellite imagery, pollution, health, botany, ethics, systems analysis, toxicology, molecular mutagenesis, and so forth.

The focus in these departments is now on detailed investigations into levels of pollutants in humans and other organisms, and subsequent recommendations on accepted levels of pollutants in fish, poultry and other animal and plant products if they are to be suitable for human consumption; the levels of green house gases and their influence on climate change, depletion of the ozone layer, and so forth. It is not yet clearly defined whether this growing trend will be geared towards educating a calibre of future scientists who would have the knowledge to predict possible environmental impact of proposed developments in land, industry and so forth, and if necessary propose some appropriate "sustainable" alternatives if so required. Those are the ones mostly needed at present; people who can use their scientific knowledge to alert decision makers and industrialists of the possible dangers or the sustainability potential of proposed new projects. This exercise is at present accomplished by environmental impact assessors, which has earned them a considerable unpopularity among the "get- rich- quick" industrialists and land developers. In developing countries, such minds are in great demand, to guard against the pollution and other destruction which would result from copying cheap industrial procedures already known to contribute to the present global warming, and pollution of land, oceans and atmosphere. Having seen the disastrous level of pollution in South East Asia, people in Africa and Latin America have much to learn from these places on the limits of economic growth, industrialization, pollution, and the displacement of the poor. The problem is, will they ever learn? Are school children being made aware of these problems?

We are back to the problem raised by Hardin over 20 years ago. How does one get the investors, giants that they are, to listen to a futurist scholar preaching sustainable development techniques which may be seen as less "economically feasible."? In the developed world, the slogan, "creating jobs" for "the people" is often used to justify the building of huge complexes which have disastrous long term environmental consequences. A current example is the proposed Athabasca pulp and paper mill in Alberta, Canada, which will add organochlorides and other pollutants into the already highly polluted waters of the Saskatchewan River which is the main source of water for the people of Northern Alberta and the North West Territories of Canada. School science still works on prestigious subject specific disciplines, and attempts to integrate or coordinate science teaching so that it addresses the impact of science and technology on society has generated an intense debate among science educators (Black, 1986; Frey, 1988; Bohm, 1984). The popularity of integrated science courses, (including environmental education) remains low despite increasing evidence that they might produce better scientific understanding in students than the subject specific disciplines (Skinner, 1987; Skinner & Fairbrother, 1988).

Z'arour (1987) reviews some of the forces hindering the introduction of Science, Technology, Society courses in the schools and addresses the prevalence of environmental issues in these programs. Apart from problems arising from the esteem accorded to the subject specific disciplines, he lists and discusses other factors, such as:

1). College and university requirements, remain traditional in their identification admission requirements. Now that STS programs are moving into European and North American schools, some universities may change their admission requirements in response to these developments, but the teaching resources for this approach remain limited.

2). Teacher power, at its height in authoritarian, expository teaching situations may be under threat due to the insecure atmosphere of enquiry STS classrooms, and hence teacher resistance may well be the greatest obstacle. The lessons of the British Schools' Council Integrated Science Project, SCISP,(Olson, 1985), and Keele Integrated Science Project, (Shipman, 1974), may be drawn here.

3). New teaching models are difficult to be taken up by teachers educated in other models. To quote Bolster (1984),. . . "Teachers' knowledge of teaching, once achieved, tends to be highly resistant to change." With the environmental issues approach as mainly outdoor and discussing unstable issues with fewer "correct" answers, teachers operating on the authoritarian model may find it out of step, insecure and irrelevant.

4). Lack of traditionally defined content to be taught interferes with most teachers' frame of mind about content.

5). The scarcity of textual materials reflecting this new thinking puts pressure on the teacher to remain traditional rather than be shallow, losing the interest of students.

6). With controversial issues on the teaching agendas, the fear of some politicians may be that teachers want to promote chaos by teaching children to . . . "question ecological consequences of community decisions." (Z'arour, ibid.). These have made some teachers bow to such "community" pressure. In the developing world, additional factors have also been mentioned, including: Inadequate facilities for teacher education, lack of necessary printed materials, (such as reference books, manuals, and other educational media) (Stynik et al., 1985, p. 6).

7). Caution on the introduction of new innovations in education in the light of past experience of unsuccessful innovations in Tanzania (Education and Production, Community school initiative (Pendaeli, 1985); The School Science Project of East Africa (Lillis & Lowe, 1987); and the Secondary Science Curriculum Experiment of Papua New Guinea (Saunders & Vulliamy, 1983).

In the case of Tanzania, for example, attempts to make elementary education "terminal" have faced tremendous resistance from parents and students wanting to follow traditional disciplines, climb the educational ladder and renew their credentials in high status professions (e.g medical sciences, law, administration and so forth). Vulliamy (1982, 1985) reports a similar trend of secondary school leavers in Papua New Guinea to seek traditional prestige, rather than think in an integrated fashion so that they can face the global realities, reflected in their own local communities. Unfortunately all of these observations are not based on systematic research findings. It is not known, for example, to what extent the status quo notion is held by teachers in secondary schools where these "high status students" work, what has become of global UNESCO-UNEP and national emphases of environmental issues in the science curricula, the relationship between school production projects and classroom interactions, and the forces directly or indirectly pressuring schools to adopt these "invisible objectives " of the school curriculum. Even the enlightening reviews of the fate of the African Primary Science Program (Yoloye & Bajah, 1983), though presenting an interesting account of the failure of western introduced projects, have not initiated research into local obstacles leading to these failures especially in the latter years when a significant number of local science teachers had been trained. In a recent study, Jegede et al. (1989) reveal that a conflict between "traditional" and "scientific" culture impedes attempts to teach science to most students in Nigeria and calls for more research on sources of conflict between traditional African and European Cartesian conceptions.

Development and implementation of EE: Success stories ?

A few reports describe success stories. Noibi (1988) attempted a survey of environmental action in secondary schools in Lagos, Nigeria and found that teachers ability to teach the techniques of persuasion through writing letters to politicians and industrialists was better than that of enabling students to engage in political action and consumer pressure. Noibi reports that the introduction of an EE action program at professional development programs and Community Youth Service Corps had an impact on the behavior of the surrounding community. People in Lagos now clean their once dirty city . . . "at least one Saturday a month." The paper, however, doesn't describe the role of politicians, businessmen and industrialists, nor describe whether this is voluntary or required cleaning. It must be pointed out that Nigeria is presently under military rule. It neither reveals the content of the learning activities of the EE program, nor appraises the contribution of this cleaning program on the broad scientific literacy of the students and the local population.

In Southern Africa, public pressure on traditional science has forced the Zimbabwe Science Project, (the most recent curriculum materials in Zimbabwe) to deliver the same old academic syllabus characteristic of the pre independent elitist schools. In neighboring Zambia, attempts to marry education and work (a diffusion of Tanzanian *Education and Work* policy, see TANU, 1974) has produced a number of success stories. One school now keeps 1000 chicks and 200 citrus trees, and also produces nitrogen fixing bacteria in laboratories to be added to soya bean farms. As Knamiller (1982) argues, such success stories are exceptional cases and most schools which have taken this path face serious problems of maintaining viable projects as well as marrying productive activities with academic objectives. The same could be true of Tanzanian secondary schools (Komba & Temu, 1986). Studies on the specific problems facing teachers and students in these teaching-learning situations are presently unavailable; so any attempts by policy makers to readdress the objectives or design professional development programs for teachers working with children in these areas cannot succeed due to lack of enough data.

In Tanzania, over 20 years of Education for Self Reliance has produced numerous enthusiasts, especially among those who have passed through the education system, and encouraged them to reflect on a utilitarian education, which includes a reexamination of the environmental emphasis expressed in the syllabuses since the mid 1970s. Many Tanzanian educators and politicians agree that the thrust of scientific literacy in general (including environmental emphasis) has been rather slow. In a speech to the Tanzanian Professional Teachers Association (CHAKIWATA) in 1988, former Chama Cha Mapinduzi (CCM) party chairman Julius Nyerere warned that while Education for Self Reliance had abolished illiteracy in the reading /writing sense, it:

> .. . . had done very little -almost nothing- to tackle technical and skills illiteracy."

and that the emerging generation of peasants,

> . . . in addition to whatever traditional wisdom and skills they can learn from their elders, need scientific and technological skills in order to build the new kind of society they need and want. . . . (*The Daily News* of Tanzania, 12 September, 1988) .

The growing trend of poor results in science subjects, in-spite of increased emphasis of these subjects in Tanzanian secondary schools worries many educators in Tanzania (Meena, 1987; Kaino, 1988; Pendaeli, 1985; Msuya & Mtui, 1987; Msemakweli et al., 1987; and Nkonoki, 1987), and so does the lack of knowledge on crucial environmental problems and the dangers of some environmentally irresponsible traditional practices (Nshubemuki, & Mugasha, 1986, O-saki, 1983, 1986). The Ministry of education has reintroduced the form 2 examination to further "monitor academic standards." This exercise could encourage more memorization of scientific concepts for the purpose of merely passing examinations. Thus, the very purpose of Education for Self Reliance, which echoed global U.N. goals to produce people who could critically evaluate the status of their environment, increase productivity through hard work, compare traditional and modern methods of doing things and make rational choices, is in great danger. The need to get to the heart of the matter is, therefore, evident. One approach is to get into the classrooms and look for linkages between national and global curriculum goals with their classroom implementation, and the forces influencing this implementation at the grassroot level. It is with this purpose that this study has been undertaken.

Summary

To summarize, the review of presented in this chapter reveals the following issues:

First, there has been a global concern on the deterioration of the biosphere ever since humans began large scale industrial activity, but more so since the First World War. Organized groups supporting the case of a clean and undisturbed environment have changed titles from environmental protectionists, preservationists, conservationists to advocates of sustainable development. The history of the environmental movement in industrialized states and the historical role of the United Nations Organization show the trend of the development of the movement. The latest efforts of the U.N. are indicated in the recommendations of the World Commission for Environment and development, which urge the world to promote a sustainable development of its resources for a steady economic growth, especially in the least developed countries. To some radical environmentalists, this seems to imply a change of tone from earlier appeals to reduce resource consumption through protection, and conservation of existing key resources.

Second, the promotion of EE has evolved from the provision of non formal education to the introduction of formal school subjects. Such subjects have ranged from combined and integrated subjects like as gardening, rural studies, environmental studies, general science et cetera to themes embedded in subject specific disciplines- including such disciplines as environmental biology, (or chemistry, physics, geology et cetera). Some programs have included environmental components in the traditional subject disciplines like biology and chemistry. The tension between integrated (or combined) and subject specific approaches to EE remains. The subject specific disciplines, often associated with traditional professions and university departments still maintain a formidable influence in science education at the expense of integrated approaches, even though the latter are often believed to be more appropriate for imparting holistic environmental concepts. This may be due to the historical association between academic status and traditional subjects.

One research direction has been concerned with surveys of existing knowledge, beliefs and attitudes of students and teachers that relate to environmental issues. It has generally been revealed that there is little correlation between the level of environmental knowledge held by a group and its attitudes towards the environment, or the behavior they display towards the environment. The development and trial of EE materials by experimental and other research procedures has led to the accumulation of various EE evaluation instruments as well as teaching/learning materials, especially in the western countries and the Soviet Union. This has investigated the role of educational media, outdoor classrooms and settings, teacher oriented and student oriented settings. In the less developed countries, including many in Africa, less has been done in this area.

Some studies on the impact of EE curricula indicate a higher success in action oriented programs from students of high socioeconomic status. Studies on the interpretation of environmental information are gaining strength especially now that the link between environmental and concept development has began to be developed by the research on alternative conceptions. In some cultures, including Tanzania, the "popular science theories" have the potential to increase alternative conceptions and together with language difficulties, may hinder free and open discussion of every day environmental phenomena.

Research into factors influencing the teaching and learning of EE has taken a historical or descriptive framework, probing social, political, economic and historical hindrances to the development of EE and other issues-oriented, science education programs. Work in this area remains limited.

Many gaps still exist, especially in the linkage between the child's biophysical (and social) environment and conceptual development of biophysical concepts. Gaps also exist in the understanding of the forces influencing the process of interpretation and implementation of global or national EE objectives at the classroom level. In Tanzania, a study of such forces may illuminate more on the rise and fall of the Education for Self Reliance Policy.

Chapter 4

METHODOLOGY AND RESEARCH DESIGN

Introduction

This study was guided by the social constructionist approach (Schutz, 1932; Berger and Luckman, 1967; Goodson, 1989). This approach is supplemented by an historical and structural analysis of science education in Tanzania. Such analysis includes an examination of its pre-colonial and colonial history, as it has influenced the process of schooling during the post independence era. The choice of methodology for this study is a reflection of the researcher's lifeworld as a school teacher in the Tanzanian Education System. Working in schools generates what Schutz called a "stream of experiences," which built up a new conception about teaching and even the subject matter to suit the emerging social reality. Through talking to "consociates" and "predecessors," one comes to define what is done and what is not, what is feasible and what is not, what works and what does not (Schutz, 1932).

Researcher's background

I was a secondary school biology and chemistry teacher in 3 secondary schools in Tanzania from 1976 to 1984. Between 1976 and 1979 I taught biology to students of forms 1 to 4 (grade 8-11) at a girl's school in central Tanzania, and was also responsible for productive projects introduced into the school program as part of the policy of Education for Self Reliance and Education (means) work, (See Nyerere, 1967; TANU, 1974). This policy was designed to integrate education and work in the schools so that students were able to "translate theory into productive practice ." As a teacher, I supervised, together with other colleagues, productive projects such as the schools pig rearing project, chicken project, a small vineyard, a millet plot, and even a beekeeping project in which we had dozens of beehives in school surroundings and actually harvested honey. As a biology teacher, it soon became obvious that the environment, whose economic potential was being tapped, also had a great educational potential, as had the productive activities in which the students were involved.

Further, the Examination Council of Tanzania issued a directive in 1976 that all secondary school pupils should do one project beyond daily homework and final examinations as part of the continuous evaluation of their school performance. It soon became obvious to most teachers, including myself, that with a view to becoming more holistic, the productive work, the project, and classroom discourse could be tied together to produce a broad science curriculum. For example, there was a lot of biology to be learned through beekeeping, animal husbandry, and the farming activities in which most students were involved. Of course, some projects were only feasible in schools located in particular environments. Fishing was only feasible near rivers, lakes or the sea; cattle rearing was most feasible in places less infested with tsetse flies; and in day schools situated in inner city environments it would be meaningless to establish animal husbandry projects since there would be no one to care for the animals after school hours or during holidays, not to mention the shortage of grazing land. However, even in these schools there were features in the environment of the school which were illustrative of specific biological concepts such as pollution from cars and factories, garbage disposal problems, domestic pets, et cetera. There was a problem of lack of fuel in inner cities, where the majority of people in the poorest neighborhoods used firewood, charcoal and kerosene. Those who were better off could afford electricity or buy gas. These issues had their place in classroom discussions on energy, ecology and sustainable development. Unfortunately, the curriculum, which was designed on the premise of subject specificity, used textbooks which were imported from different cultures and were was not focused on integrated teaching. Political will seemed very high; ESR objectives had been set since 1967, but classroom teachers were ill prepared for this re-thinking. Resource materials and personnel were lacking so that within three years it became clear that the ESR curriculum could not be realized.

When transferred to another school, I was involved with teaching the Advanced Level biology syllabus and a few lower form classes in a full range (form 1-6) secondary school. Most of the A level syllabus was similar to the former Cambridge Higher School Certificate syllabus, even though at this time student achievement was determined by locally developed examinations. For two years, I rushed students through a theoretical discourse of taxonomic hierarchy, organismic physiology and biochemistry, and evolutionary biology, in preparation for a competitive national examination. With the role of the surrounding environment still in mind, I often took students outside to observe natural phenomena. For example, we had a careful tour around the school farm and other surroundings to observe the diversity of flora and fauna. Then, through homework, students further explored the school farm and nearby environments. After this we would discuss the principles and controversies of classification systems, and study leaf and stem morphology, and anatomy in laboratory settings.

After two years, I left the school to pursue graduate studies in science education at the Center for Science Education, Chelsea College (now Center for Educational Studies, Kings' College (KQC), London). The subject I chose for research was students' beliefs, knowledge, and attitudes towards the environment which I pursued vigorously (See Osaki, 1983, 1986). I also worked on a curriculum unit aimed at adapting the Nuffield Biology[*1] materials in teaching the subject of genetics using examples common in East Africa. After graduate studies I was posted to an urban school where I taught for about one year before moving to the University of Dar es Salaam as a teacher educator. I worked there with second year science education undergraduates for over three years and coordinated the first year education program for three years among other things. The task of preparing teachers for secondary schools is often designed and executed in such a way as to provide opportunities for future secondary school teachers to benefit from the experience and insight of people who have had professional experience in similar circumstances. I believe that my experience and that of my colleagues will stimulate new thinking among future student teachers.

Researcher's concerns

My main concern is with the teaching -learning process of biology and other science subjects at the secondary level, and teacher preparation for science teaching across the curriculum in Tanzania with a focus on the environment. For, whereas our biophysical environment is one of the richest in the world, and the people in local communities of the area depend directly on its resources for their survival, science education in the schools has hardly reflected this apparent need. It has propagated the academic tradition of bookish learning instituted since colonial days, and remains unrelated to the realities of the environment which form the basis of survival of all species. The mass media has often reported various efforts of global organizations such as UNESCO, UNEP, IUCN, WWF and the Tanzanian government in promoting environmental education. However, recalling my experience as a school teacher, I saw little support for the classroom teacher other than rhetoric and statements of global objectives. As the purpose states, this study hopes to reveal the forces at play in the classroom, and develop some practical suggestions for teachers to make better use of existing global, national and local resources. Since it was believed that the environment surrounding each school might influence what teachers can do, schools of differing environmental zones were involved in this study.

Characteristics of the environmental zones

The selection of schools was based on the environmental zone in which they were located. The three selected environmental zones included Coastal, Inner City, and Tropical Forest respectively.

The Coastal Zone is located close to the Indian Ocean and provides the opportunity to use intertidal flora and fauna in biology teaching. On days when the tide is low the opportunity to study tide pools during school hours exists. Along the Dar es Salaam coast, interesting flora include an extensive mangrove vegetation and its associated fauna (McCusker, 1973) , and the many species of algae brought in daily during the evening high tide. Large and small sea vessels, engaged in fishing or unloading cargo are a common sight. This can be a direct illustration of the impact of human activities on the marine ecosystem. There is, of course, the terrestrial environment surrounding the school on the fringe, which differs from that further inland. One school in this category was chosen for this study, in an effort to examine the possible utilization of these environmental features in teaching-learning activities.

The Inner City Zone.

As the name implies, this zone is located in the midst of the main commercial area of the city. The environment is dominated by high and low rise buildings and busy roads, often with dense traffic and air which is heavily polluted by automobile emissions. At the time of the study, few trees were found in this area. Most inner city landowners in Dar es Salaam would rather build another kiosk at the expense of the environment. Some inner city schools have the advantage of being close to facilities that could strengthen a science program, such as consultant hospitals or large laboratories. The appearance of the zone is itself a metaphor which can be used to illustrate human alteration of nature for good or bad consequences. In terms of the city plan, this zone gives way to the coastal zone and some schools are within walking distance from the seashore. The difference is on the nature of the sea around it. The chosen school was within a hundred meters of the sea but in an area with little intertidal vegetation and not much biological activity. Heavy traffic problems made it difficult for teachers to get students to the sea for educational purposes. Thus the immediate environment suitable for teaching was the surrounding compound of the school and its adjacent infrastructure. Teachers and students of the inner city and coastal zones often intermingle in residential areas within the city. Therefore, the zone difference only exists while they are in school.

The Tropical Forest Zone

On the outskirts of the city of Dar es Salaam is a region which can ecologically be described as the tropical forest zone. The Pugu Forest Reserve is within a few kilometers of the old schools of Pugu and Minaki. The forest has been largely disturbed by man due to cultivation and other activities such as hunting and gathering. The surroundings of these schools , however, are totally different from those of the other two, in spite of their being within the same city. These are full boarding schools with surrounding areas occupied by sparsely populated village communities, and the area is evergreen. The Self Reliance economic projects are strong in these schools, with students operating farming, animal husbandry and retail shops as part of their daily activities.

CHARACTERISTICS OF THE SCHOOLS IN THE SAMPLE

Each of the schools chosen varied in its history, size and type of administration. The schools were School A (from the coastal zone), School B (inner city zone) and School C (tropical forest zone).

School A

School A is an old school whose history dates back to the 1950s when it is was an all Asian secondary school. It was nationalized, in the 1960's along with other racially designated schools, and since then attendance has been open to students of all races. It is located close to the mangrove creek east of the city, near Selander Bridge which separates the city center from the fashionable suburbs of Oysterbay and Msasani Peninsula. Mangrove vegetation is a significant feature of the environment east of the school, linking the sea and the land at this point. The

Muhimbili Medical Center, (a consultant hospital adjacent to the University Faculty of Medicine) is within a fifteen minute walk of the school. Roads and residential buildings surround the remaining environment. This is a relatively large school with a student population of over 1500 students running in two sessions, with teachers and students alternating weekly between morning (7.30-1.30 a.m) and afternoon (1.30-6.00 p.m) sessions. Like other schools in the city, the student intake has recently been doubled in order to accommodate a rising pupil population in the city. *2 In this school there were 12 classes of form 3 students (approximately 35 students per class) which were taught biology by two full time teachers. The other grades ranged from form 1-6. The researcher was able to chat with the head of the biology department before meeting the form 3 teachers.

School B

This school is located inside the city center close to the seashore. It is separated from the sea by a road and its surroundings include cathedrals, banks, government offices and shops. It was originally a Catholic school built in the 1950s, but later it was nationalized and now caters for children of all religions. There are 4 classes of form 3 students taught by 2 teachers .The school is predominantly attended by children of middle class parents including children of senior government officials. There were frequent cancellations of these form 3 classes. On one occasion, afternoon classes were cancelled in favour of an address by a local religious leader who talked on A.I.D.S, extending his scheduled lunch hour talk into 3 class periods. Other instances ranged from student participation in street cleaning (to "assist" the City Council), to a day off for all the city schools to welcome the African National Congress leader Mr . Nelson Mandela, who was visiting the country after being released from prison. To these would be added days when the teacher was ill or had a sick child and couldn't come to school. Despite these interruptions, it was possible to make 4 observations in this school. In two other inner schools, it was practically impossible to conduct the study, due to : (a) teachers' frequent failure to attend classes, and giving students materials to copy into notebooks instead; and (b) teachers' resistance to participate, albeit for fear of having an observer in their classrooms. Of the two teachers in form 3, only one qualified to take part in the study. She had five years of teaching experience, three of which were in this school. The other had only taught for 2 years and was struggling to begin undergraduate studies at the University of Dar es Salaam the following term.

School C

School C is a boarding school located about 35 kilometers out of Dar es Salaam. It is an old school, with a history that can be traced back to the times of British colonial rule. It is built on a hill and surrounded by villages. Many trees which have been planted around the school add to the landscape and could be used in the teaching of biology. The school designated "Agricultural biased," owns a modest coconut plantation and keeps animals as part of its "self reliance" projects which are maintained by students.

There were 2 classes of form 3 students at the time of the study, taught by one teacher. The form 3 teacher, held a masters degree in biology from the USSR and had worked in this school for 6 years. After my first observation, the teacher fell ill and was admitted at Muhimbili Hospital. For this reason she couldn't proceed with the study. Since a new form 3 teacher didn't arrive for 3 weeks, I decided to observe the form 4 class instead. The form 4 teacher, who holds a Diploma in Education, had taught in the school for 3 years. The headmaster was supportive of the research and the researcher. He even suggested that I also help in evaluating teacher performance and report to him problems of inefficiency and ineffectiveness. I declined, since this would conflict with my desire to be a neutral observer, and erode teacher confidence and cooperation with the research process.

METHODS OF DATA COLLECTION

The study involved both qualitative and quantitative techniques.

Qualitative techniques included interviews, observations and field notes.

Quantitative techniques included: a questionnaire to teachers designed to gather information on the experiential, academic and professional background of the teacher, (Appendix B) and a student questionnaire (Biology Learning Activities Checklist [BLAC] See Appendix C), designed to determine their perceptions of the kinds of activities in which they had been involved during their learning of biology in school and elsewhere.

Development and administration of the Instruments

The following instruments were developed for the study.

(1) *Interview guides*, for the teachers, curriculum developers, and ministry administrators and environmental officers (See Appendices E, F, G respectively). The questions were designed to explore their conceptions and involvement in the development of resources and teaching of EE. They were validated by seeking expert opinion from experienced science educators. Three science teacher educators at the Department of Secondary Education at the University of Alberta assisted in this validation prior to use. Interviews of various educators, including curriculum developers, educational administrators and classroom teachers were designed to explore their conceptions of environmental education and their knowledge of any programs that were developed for use in schools. There were also interviews of United Nations environmental officers designed to explore their support and service to schools.

(2) A *Science Teaching Observation Guide* (STOG, Appendix A) for guiding the researcher in observing and recording classroom activity and discourse was developed. This instrument was validated by seeking expert opinion from 3 science teacher educators at the Department of Secondary Education at University of Alberta and 2 experienced biology teachers in Dar es Salaam schools. Classroom observations were conducted by the researcher in form 3 classes (form 4 in School C) in the schools involved in the study. The number of observations ranged from 4 in School B to 10 in School A. The developed observation instrument (Appendix A) was used to guide the observer.

(3) A *Biology Learning Activity Checklist* (BLAC Appendix C) was also developed for the study. It was validated by seeking expert opinion from 3 science teacher educators at the Department of Secondary Education at the University of Alberta and 2 experienced biology teachers in Dar es Salaam schools. Then it was tried in one form 3 class in a Dar es Salaam school. The validated form had 38 items for the form 3 classes and 45 items for the form 4 class. This was due to the different levels of content coverage in these two grades. The BLAC was administered to participating classes at the end of the classroom observation period in a supervised classroom session by myself and an assistant.

These data were supplemented with examination of official reports (especially School Inspectors Reports at the Ministry of Education, Reports of UNESCO-UNEP sponsored teachers' workshops held since 1987, and papers presented at those workshops) and follow up interviews to government land and environmental management officers, and the coordinator of MALIHAI, a local wildlife conservation education program. All classroom observations were done by the researcher. An assistant helped with the trial and administration of the student checklist (BLAC).

SELECTION OF THE SAMPLE

The sample was selected from policy officials, educational administrators and secondary school biology teachers (form 3 and form 4). Two criteria were use to select the sample. One, people who were believed to have an influence in the day to day implementation of the science curriculum, especially the development and teaching of the biology syllabus, and two, those who cooperated fully in the interview and classroom observation process. Policy officials included the Chief of Environmental Education at the United Nations Environment Program office in Nairobi, a curriculum coordinator responsible for the subject of biology in Tanzania, a Ministry of Education administrator responsible for environmental education, a land use planning officer in the Ministry of Lands, Natural Resources and Tourism and the coordinator of Malihai clubs. All were interviewed for approximately one hour each. A semi-structured interview format was used. Some interviews were tape-recorded, while notes were taken for most of the others. Most interview respondents requested not to have their voices tape-recorded, in spite assurances of confidentiality and anonymity.

Selection of teachers

Teachers were selected on the basis of school zones, their professional experience and a minimum of 3 years teaching in the same school. Since the study area was the large urban center of Dar es Salaam with over 20 schools, a selection of teachers was done on the basis of convenience to the researcher, one school being selected from each of the 3 environmental zones as stated earlier. At School A, (Coastal zone) two form 3 teachers were selected; at School B (Inner city zone) one form 3 teacher was selected, and at School C (forest zone) only one form 4 teacher was available for the study. (See characteristics of the schools in the sample, previous section).Teachers were observed in class once a week during a double lesson. After every classroom observation a short interview was conducted about the lesson, and notes were taken. A longer interview (about an hour for each teacher) was conducted at the end of the observation period.

The life histories of the teachers was follows: From School A, two teachers were selected, known here as Mrs. Maganga and Mr. Mifano. Mrs. Maganga is a graduate of Biology from the University of Dar es Salaam (1977). She has taught Biology at a Dar es Salaam secondary school for 7 years where she was also head of a department and a Deputy Headmistress. Then she was transferred to School A. She has since won a scholarship and in 1988 completed a M.Ed at a University in Europe. She was now teaching biology in 6 classes in School A. The other teacher, Mr. Mifano, is also a 1977 graduate of the University of Dar es Salaam. He has taught biology at all levels from form 1 to form 6 in 2 schools in the Dar es Salaam region during his career. At the time of the study he was teaching 6 streams of form 3 biology at School A.

In School B, the participant teacher was Mrs. Chapuchapu. She completed a Diploma in Education from Dar es Salaam Teachers' College 5 years ago, and has since taught in 3 schools, two in the interior of Tanzania. This means that she has had less classroom experience than the two teachers in School A, and has not had university education.

In School C, a form 4 teacher Mr. Moyo participated because the form 3 teacher originally involved in the study withdrew for medical reasons. Mr. Moyo is also a Diploma holder from the Dar es Salaam Teachers College and has taught in the school (C) for 6 years.

Characteristics of the student sample

The student sample was one complete biology class of each teacher who participated in the study. They were part of the classroom observations and also completed the BLAC questionnaire. A total of 99 questionnaires was returned by the students. The composition of the total sample is as shown in Table 6.

Table 6 : Characteristics of the student sample.

School	No. in the sample	%	Form (grade).
1	46	46.5	3
2	30	30.5	3
3	23	23.2	4
Total	99	100	

Most students in the sample had originated from primary schools around Dar es Salaam and Morogoro. (See Table 7).

Table 7: Primary School origins of the student sample

Region of Tanzania	% in the sample
Dar es Salaam	78%
Morogoro	10%
Coast	01%
Others	11%

In terms of parental occupation, children's parents ranged from professionals (doctors, teachers, accountants, etc.), semi professionals (nurses, clerical workers etc.) to peasants and the unemployed.

Table 8: Parental occupation of the student sample.

Occupation	% Fathers	%Mothers
Professional	32	17
Semi professional	28	19
Peasants/farmers	27	39
Jobless/etc	11	23
Other	02	02
Total	100	100

In terms of regional distribution by parents' or child's place of birth within Tanzania, an interesting distribution was found. As can be seen in Table 9, some regions of Tanzania are more represented in the sample than others.

Table 9

Regional[3] distribution of the student sample

Region	% Students' parents originating from the region	% Students born in the region
Dodoma	1	0
Arusha	1	2
Kilimanjaro	23	14.1
Tanga	0	08.1
Morogoro	13	10.1
Coast	02	02
Dar es Salaam	03	34.5
Lindi	02	01
Mtwara	01	01
Iringa	05	03
Mbeya	05	02
Singida	01	01
Tabora	06	02
Rukwa	01	01
Kigoma	02	02
Kagera	04	04
Shinyanga	01	02
Mwanza	04	03
Mara	10	05.1
Zanzibar	01	0
Total	99	100

[3] In this Table, the regional distribution of the sample is meant to show relative movement of people from various parts of the country into the city of Dar es Salaam, and their relative representation the form 3 classes in the

sample . There has been a strong argument for regional imbalance in access to secondary education in Tanzania. (See Samoff, 1989).

Summary of data collection techniques

Classroom Observations: Table 10 presents the field work plan for classroom observations (Done between 8 February and 4 May, 1990).

Table 10: Classroom observation schedule: 8/2/90-4/5/90.

School Observ.	Teacher	Grade	Times of observtn	Dates	Total
A	Mrs. Maganga	Form 3	7.30 -8.50 a.m	9/2-4/5/90	10
A	Mr. Mifano	Form 3	10.50-12.10 a.m & 2.30-3.30 p.m	8/2-26/4/90	10
B	Mrs. Chapuchapu	Form 3	9.00-10.20 a.m & 3.30-4.30 p.m	24/3-24/4/90	4
C	Mr. Moyo	Form 4	9.00-10.20 a.m & 11.00-12.20p.m	27/2-3/5/90	7

Interview plan:

Teachers: A 10-20 minute minute interview before or after each observation. Notes were taken during the interviews. A one hour interview was held at the end of the observation period. Mrs. Maganga was interviewed on 4/5/90, after administering the student questionnaire (9.00-10.00 a.m). Mr. Mifano on 27/4/90, morning, (9.30-10.25.) Mrs Chapuchapu on 4/5/90, (11.05-11.45 a.m) and Mr. Moyo was interviewed on 3/5/90, morning from 11.00-11.35.

Biology Curriculum Coordinator was interviewed for about 2 hours in the first week of February, 1990. Ministry Official (Coordinator of UNESCO-UNICEF activities including EE was visited 3 times, February and March).

School Inspectors: The Director of the School Inspectorate Division gave a half hour interview during early March, and then allowed me access to School Inspection Files which contain detailed annual evaluations on the state of teaching and management in schools prepared by visiting teams of subject inspectors in all educatonal zones of the country.

National Environment Management Council: A 30 minutes interview with the Pollution Control Officer and Land Use Planning Officer was held on 23/3/90.

Malihai Club: I visited Arusha, headquarters of Malihai Clubs and talked to Mr. Ottaru, the National Coordinator, and Mr. Mangowo, a Conservation activist, on their work in promoting Conservation Clubs in Schools. The interview lasted over 2 hours (2:00 pm to 4:15 p.m)

UNEP Offices (Nairobi) were visited on 7/5/90. Dr. Michael Atchia, Chief of Environmental Education, was interviewed from about 3.00-4.30 p.m. The morning (8.00-3.00 p.m) was spent in the UNESCO-UNEP library.

DOCUMENTS CONSULTED INCLUDE::

1. Report of the Sub Regional Workshop on EE in East, Central and Southern Africa, held at Malawi, 9-12 december, 1987.
2. Reports on the National Training Workshops of EE (Tanzania), 1987, 1988, and 1989 and papers presented at the Workshops.
3. Annual School Inspection Reports, by Zones: Ministry of Education Files.
4. Annual Reports of MTUU (Mpango wa Tanzania-UNESCO-UNICEF-Tanzania Unesco-Unicef Program).

5. The Report of the World's Commission on Environment and Development (The Moscow Conference Report, 1987).
6. Habari za Malihai (Malihai Newsletter).
7. Akili na Zuzu-Hadithi ya Wakulima Wawili- A Story of Two Farmers, by J.D Bygot and J.P. Hardy.

These, and others, have been instrumental in the development of arguments for the thesis.

NOTES

1. Nuffield Biology was an activity oriented curriculum project (along with Nuffield Physics and Chemistry) developed for British grammar schools during the 1960s. It is a program which was designed for the inquiry oriented, probably high ability student and focuses on British biological research experiences suitable for student experimentation at the "O" level. Many teachers, even in Britain, have expressed reservations on the use of these materials due to their difficulty level (Shayer, 1972 & 1978). They were introduced into East Africa in the 1970s and adapted to become the School Science Project. The experimental approach of the materials seems very exciting for "O" level biology, and I took the chapter on genetics and tried to inject examples from recent research the genetics of some East African species (e.g Monarch butterflies etc.) which are familiar to most East African school pupils.

2. This policy now extends throughout the city, except for the boarding schools. Students alternate sessions each week, so if half of the school is in the morning session this week, the other will be in the afternoon session, and they will switch sessions the following week. The morning session periods are 40 minutes each, while the afternoon session periods are 30 minutes. One teacher told me that afternoon periods had to be shortened to enable students to get home before it was too dark and when transport was still available.

CHAPTER 5

RESEARCH FINDINGS

Introduction

This chapter presents the findings of the study. It is divided into four parts, each responding to the research questions of the study. These include:

(1) Participants' perceptions of environmental education;

(2) Content of biology lessons;

(3) Participants' views on forces influencing environmental education, and,

(4) Students' perceptions of biology learning activities.

Participants' perceptions of environmental education

The interview process revealed a high level of awareness of the philosophy of EE, especially at the official level: Most officials were eloquent on the meaning of EE, giving basically the 1977 U.N.E.S.C.O -U.N.E.P definition, namely:

> ... education aimed at enabling learners to understand, appreciate, and preserve the natural environment around them.

United Nations' Environment Program Officer

The UNEP chief didn't labour to define, but directed the researcher to look up the publications of UNESCO and UNEP in their well stocked library in Nairobi. His personal views on the subject were contained in a short paper titled Brief on Environmental Education and Training prepared for a UNEP Regional Youth Focal Points Round Table Meeting, held in Nairobi in January, 1988. He defines EE as:

> The educational process dealing with man's (sic) relationships with the Earth and his effect on the Earth and his relationship with his natural and man made surroundings, and includes the relations of energy, population, pollution, resource allocation and depletion, conservation, transportation, technology, economic impact, and urban and rural planning to the total human environment. (Atchia, 1988, p.1).

He further distinguishes *general environmental education and training* for creating general awareness as a whole from *specialized environmental education and training* designed for professionals such as biologists, hydrologists, architects, engineers, and so forth.

In the U.N. literature, the meaning of EE has evolved from aesthetic concerns on nature "preservation" to the "conservation" of rare species or ecological habitats, to the "protection" of natural heritage from human destruction and the present emphasis on the "sustainable use" of existing global resources.

The National curriculum coordinator (biology) who was interviewed had written a number of papers on the subject and presented them at national workshops organized by the Ministry of Education with UNESCO-UNEP sponsorship. In one paper, the word 'environment' was defined as:

> . . . surroundings (material and spiritual influences) which affect growth, development and existence of a living being. (Longmans' English Dictionary, 1968, quoted by Gunze, (1986).

Gunze further quotes Kelly (1977), and Zoller (1984) to emphasize the main aims of EE, which are:

> . . . increasing student's awareness of the system (ecological, socio-economic and socio-cultural) within which he lives through direct interaction between student and environment. (Kelly, 1977).

and

> . . . equipping students with all the fundamental relationships within as well as problem solving skills, in order to facilitate their development into environmentally oriented, competent, decision- making agents of social and technological change.(Zoller, 1984).

In the same conference, several other definitions were given, describing EE as:

> . . . the process of recognizing values and classifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness of man, his culture and biophysical surroundings. Also it includes a practice in decision making and self formulation of a code of behaviour about issues

> concerning environmental quality. (UNESCO, 1977, quoted by Rajabu, 1986, p.47).

Rajabu adds that the above definition

> . . . underlines too strongly a conservationist viewpoint and should be extended to include some purely educational beliefs. (p. 47)

He didn't specify these "purely educational beliefs", but he went on to argue in support of Education for Self Reliance. During interviews, both the Biology Curriculum Coordinator and ministry coordinator agreed that U.N. guidelines should be used to guide the development of EE materials.

As it can be seen, the definitions given above reflect the conceptions of the ministry officials of the meaning and purpose of EE, and are directly quoted from U.N. publications. Viewed superficially, they show that the official definition is in line with the global trends as defined in the UNEP literature. However, they rarely sounded like personal beliefs of the officials interviewed. Reflecting on the translation of U.N. goals into national objectives, a number of problems seem implicit in these definitions:

(1) These definitions are presented in a decontexualized manner and make the local workshop look like another global forum airing abstract thoughts of ecologists. In other words, they do not operationalize global goals into specific national objectives given the local environment in Tanzania.

(2) Ministry officials (See, for example, Rajabu, quoted above) too often resort to uncritically supporting "Education for Self Reliance" when they know very well that this policy has had serious problems of interpretation and implementation.[*1]

(3) These definitions do not address the need to adapt a global definition to the historical and cultural contexts of Tanzania. (Such as the need to reassure the people of their responsibility on the custody of the environment and hence the necessity to better understand and manage it, or the role of traditional education.

(4) There was no voice from the school teachers on what environmental education in a school situation might be. Teachers were more concerned with getting their students through the national examinations, and were looking for better teaching notes for use in their teaching. One topic, Parasites and Diseases, was singled out as requiring teaching notes, and some teachers had volunteered to research on it from reference books and develop teaching notes which then be made available to other teachers when completed. None of the teachers indicated any serious interest in environmental issues as they relate to the teaching of biology at form three level.

Thus, definitions such as these tend to end up at echoing global guidelines rather than using them to define what those guidelines would mean for the Tanzanian school curriculum.

Classroom teachers' perceptions

The UNEP workshop in which the above definitions and issues were discussed was held in Dodoma during 1987 (UNESCO-UNEP, 1987). About one third of the participants were school teachers, the rest were mostly Ministry of Education desk officers. There was a great gulf between school teachers and ministry bureaucrats, reflected in the workshop proceedings by the dominance of rhetoric by the latter, while the former retreated to silence and, as was learned during later interviews, lack of concern. When teachers were asked what they understood by the syllabus statement that biology is about . . . "knowing ourselves and our environment", all teachers said that it was meant to enhance the understanding and improvement of the surroundings in which we live. When asked how this was being done at the school level, few had any concrete examples either from their teaching or daily school activities except for the occasional cancellation of classes to let students pick up litter in the streets. None of the teachers in the study had attended the 1987 workshop or subsequent workshops (1988 and 1989) organized by the Ministry of Education over the last three years. Only two of the teachers (out of four in the study) were university graduates. The other two held Diplomas in Education. Throughout the Eastern zone, with 37 Secondary schools in 1989, there were only 41 biology graduates in the teaching force. Of the remaining biology teachers, 64 held post form 6 Diplomas of Education from either Chang'ombe, Kleruu, or Mkwawa Teachers Colleges, while 5 were direct form 6 (grade 13) school leavers who had not completed any studies of teaching and learning processes. With the majority of the teaching force in the Diploma and Form 6 leaver category and with a lack of supporting seminars and materials, concepts of environmental interactions could hardly be clearly understood.

In sum, while policy makers and curriculum developers were echoing UNESCO and western conceptions of EE, they had not provided opportunities for redefining these concepts in the contexts of the teachers in the schools, let alone the students for whom it was developed. An examination of the papers presented at the EE workshops over the last 3 years revealed that none had, for example, examined the conceptual elements in the U.N. definition of EE relevant to the situation in Tanzania, (for example, the varied illustration of ecological concepts in our lacustine, marine, tropical forest, montane and the numerous savanna environments as featured in various school and home locations). None examined what an environmental approach in our schools would mean in terms of curriculum orientation, classroom learning activities or support mechanisms needed to encourage the enthusiastic teacher.

At the global level, conceptions were carefully worded and conceived in terms of developing the notion of the wise use of resources and the movement towards sustainability. Concerning the interpretation of global goals of EE as stated in the Belgrade Charter (UNESCO, 1976) or Moscow declaration (UNESCO, 1987) and other key guidelines, the Chief of EE at UNEP headquarters maintained that:

> "Our main job is to produce various resources and make use of the experts we can find. All information is distributed to ministries of education. What they do with it is entirely their own affair. "

(Interviewed on 7 May, 1990 in Nairobi).

Thus, conceptions of EE, while well reflected in the writings of seminars and workshop papers, were not specified to suit the Tanzanian situation at policy level. No programs, or immediate plans for programs of EE in the biology syllabus were available. This lack of program may partly explain the lack of specific objectives for EE in the country. Global experts said they had done their part and governments were responsible to do the rest. Teachers in the sample schools had not attended any workshops on EE and were strictly observing a prescribed biology syllabus designed in the mid 1970s. The insistence on the syllabus to treat biology as "knowing ourselves and our environment" didn't appear to be clearly understood or articulated by interviewed teachers. This has implications for their ability to teach to the global objectives. There was little difference in classroom strategies between schools or zones in this context, although there was some variation on the awareness based on educational background of the teachers.

Content of biology lessons

Classroom observations occurred during routine/teaching learning-situations. Although it would be pointless to claim that the presence of the observer had no effect on the teaching/learning process, the observer visited each participating classroom on at least four occasions and the influence of his presence appeared to diminish with each visit. Teaching went on freely and teachers maintained the same manner of interaction with the students. The aim of the observations was to determine how teachers interpreted EE as reflected in the teaching of biology in their classes. The environmental content of a lesson depended on the teacher's construction about science teaching as well as the nature of the topic under discussion on that day.

Teachers' construction of science and science teaching.

The observed mode of teaching among the four teachers in the sample may be classified into three categories. There was one teacher who favoured inquiry teaching and persistent questioning, two were characterised by short lecture lessons which included note giving on the chalkboard for students to copy, and one who combined discussions, some questions and note taking throughout the lesson. For the period of about 10 weeks when the observer was at the schools, no practical (laboratory or otherwise) classes were observed to be conducted by any of the teachers in the study, neither was any excursion or field work seen.

Inquiry and persistent questioning teaching style

This style was exhibited by Mrs. Maganga at School A. It is characterized by the teacher's challenging questions to students during the course of the lesson. Questions included open questions such as "If you were swimming and suddenly you fail to balance (in water) how long do you think it will take to die?", to closed types such as, "How many parts of the nervous system are there?" Good questioning requires a considerable mastery of the subject matter, of concept development, and the management of wait time. From reading the Annual Reports of School Inspectors over the past three years, one notices that these qualities are found in a relatively few teachers in Tanzania, and usually among those who have had good academic and pedagogical education and considerable professional experience. Mrs. Maganga has many qualities in this respect. Her teaching was characterised by, among other things, persistent questioning to promote student participation in the generation or construction of biologcal knowledge. A good example can be quoted from the teacher's treatment of a portion of the topic of Respiration, subtitled *Drowning and poisoning*

Teacher writes *Drowning and poisoning* on the chalkboard, then the lesson proceeds as follows:

Teacher: I want to discuss this in order to help you see some dangerous things associated with breathing. Let us start with drowning.

T: How long does it take someone to drown? (Pause)

Students: Silence.

T: If you are swimming and suddenly fail to balance, how long do you think it will take before you die?

S: Silence.

T: Will it take, one minute? One hour?

S: Silence.

T: Come on! You must have some idea.

S:..1. Three minutes.

S:..2.........(murmur, inaudible).

T: How long will it take?

S:..3. It depends.

T: On what?

S:..3. On your energy.

T: Your energy- if you're healthy and strong it may take longer than if you are weak.

[Two latecomers enter, the teacher tells them to see her at the end of the class].

T: The moment you step in water and drown, your lungs aren't specialized to absorb oxygen from water.

[More late students enter and greet: 'Goodmorning teacher.' Teacher replies: 'I don't want your goodmorning. See me after class.]

T (continues with the discussion): It takes a few seconds to lose consciousness. What part of your body is damaged when you lose consciousness?

S:..2 Brain.

T: Yyeees! The brain is sensitive to oxygen loss.

S:..5 Your stomach also gets very big. (The whole class burts into laughter).

T: Why?

S:..4 You drink water too much.

T: Yes, when gasping for air.

Teacher ends section with a few words on the board: Drowning, lack of oxygen, gasping for air, brain sensors Oxygen deficiency.

Perhaps students will be able to put this together after further reading into their notes. As it can be seen from the transcript, students language ability in this class was low, few questions were answered promptly, many students were coming in late. Moreover, in this case, a misconception has been introduced when responding to Student 4. When one drowns, the stomach doesn't "get big" only because of drinking. The movement of water into the body cells to cause turgidity is due mainly to osmosis, which these students must have learned in previous classes. Pressed by a lack of time the teacher moved on.

T: (continues, writing on the board) *Poisoning.*

T: Feeding movements, like those of breathing, are also coordinated by the brain. Let us list down the kinds of poisoning we know around here.

Mushroom poisoning. . . . (unrecorded description)

[another late comer enters.]

T: Another late comer! Like the others, see me at the end of class.

T: Number two, Cyanide poisoning. This one blocks respiration. It prevents cells from taking up oxygen. This is dangerous. Don't fumble with cyanide compounds in the labs.

T: (continues) Tetanus poisoning (lock jaw). This is due to a bacterium called Clostridium. These are present on the tips of nails or *"michongoma"* (thornbush) thorns.

T: Do you know anything about the immune system?

S: Silence.

T: Tetanus is 50 times more poisonous than cobra venom. If it gets into your system you can die very quickly. Your jaws lock and are unable to open again.

(Lesson observed on 5/2/90).

This lesson reflects three things about the teaching method used. First, this portion of the lesson is not mandatory in the syllabus, which means it is not usually examined. The teacher rightly thought it would be an interesting and important section to discuss with her class. Second, student response to questions was poor. This may be due to their inability to express themselves in English, which was used throughout the lesson by this teacher, or their anxiety to write down as much as possible (since the teacher never gave separate notes for them to copy down). Third, since it was Monday morning, many students were late for class due to transportation problems. After the lesson the teacher said that she had included this portion to give them ideas about real life experiences of respiratory nature they may encounter. Asked if it would have made it easier if she had practically demonstrated one of the things she was discussing, she said:

> . . . I prefer to let them design their own experiments. I have given them an assignment to think of any experiments they would like to do on this topic. (i.e, respiration). This makes them think...you know.....But so far none of them has come up with any suggestion and the topic is about to be completed. These people don't want to work hard at all.

The test for this approach was on the Regional Science Fair held in nearby Azania Secondary School three months later. There was no entry from School A in this subject. This is not to say other schools did better. There was only one biology project. The few others were physical science projects. Perhaps this teacher's method needs more time for the students to become confident with working on their own and only resort to the teacher for help. And, of course, this teacher needs support. If she remains alone in encouraging students to think about experiments while other teachers continue to spoon feed them with notes and 'model answers', she is likely to be resocialized and forced to reconstruct her teaching style to suit the status quo.

In teaching other lessons in the following topic, this teacher also used models, as in a lesson on the structure of the brain (19/3/90). Following the observation and sketching of a human brain model, the teacher requested the students to look up the diagram of rabbit brain in their textbooks and compare it with the human brain. In this class, the students appeared willing to draw and observe the structure of the human brain, but didn't seem very enthusiastic about making a comparison to the rabbit brain. Most of the existing text books describe the systems of the rabbit, even though most Tanzanian students may be more familiar with the rat and mouse. Thus it seems that the books' discussions require students to study less relevant organisms. Language was also observed to hinder classroom discourse during the discussion of the parts of the nervous system as recorded in this extract of a lesson on 9/2/90.

[The teacher has just started a discussion on the role of the peripheral (autonomic) nervous system, and proceeds to involve the students through questions.]

T: How many parts of the nervous system are there?

S: Silence.

T: There are two parts. Can anyone name one of them?

S: Silence.

T: One is the Central Nervous System. (writes it on the chalkboard). What is the other?

S: Silence.

T: What is the opposite of central?

S:..1 Far.

T: Far?... Any other answer?

S: Silence.

T: Peripheral. Say after me. Peripheral. (writes it on the board)

S: (together) Peripheral.

T: What is the centre of Dar es Salaam?

S: Silence.

T: Do you know the Central Police Station?

S: (choral) Yyyeeeess.

T: Is it at the centre of the city?

S: (choral) Nooo.

T: Right! It is central only functionally, but is not at the centre of the city. What are the other stations?

S..1 Changombe.

T: Yees! Another one?

S..2 Kilwa Road.

S..3 Kariakoo

S..4 Chuo Kikuu . . . . etcetera.

There were no teaching media to introduce this somewhat difficult concept of the Central and Peripheral nervous systems. The city structure analogy seemed to help students get the point of the peripheral system. Language difficulty made it difficult for them to respond to very direct questions, until the teacher had taken them a long way. This was a skilful teacher, though. Other teachers, including some who declined to take part in the study, prefer to switch to Kiswahili language when they find that students are not responding enough. This practice is not encouraged by the Ministry of Education or the School Inspectors, and teachers fear being viewed as ineffective and incompetent by using Kiswahili in class, even though they may have difficulty expressing certain concepts in English themselves. Two young diploma teachers, perhaps knowing that they would mix languages, asked the researcher earlier on whether this study had any connection with school inspectors or the MOE. Even when the researcher assured them that it hadn't, and that participation was optional, they quickly asked to be excused from participation.

> . . . "we see many people administering questionnaires these days, some even want to enter the classrooms. This is a...sort of..scaring, we don't know who these people *really* are, what they are *really* doing.., please give me time to think and I will reply tomorrow." was one reply.

When I returned the next day the teacher asked to be excused from participation,

> . . . " I have thought about it, but I still am not ready to participate, I'm sorry." he said.

The problem of "falling standards of English proficiency" in schools has , for long, been over emphasized in Tanzania. Attempts to introduce a Kiswahili medium of instruction in Secondary schools were shattered when former President Julius Nyerere, the man who once attacked English for propagating a colonial hang over, changed his mind and was encouraging every effort to strengthen proficiency in the English language, as a "window of the world." A British Council supported English program continued in the schools at the time of this study, run from the Faculty of Education of the University of Dar es Salaam and the MOE. It involves, among other things, a compulsory english language course to all form one freshmen, taught by all subject teachers (including science) for six weeks prior to beginning other lessons. It is followed by a strong presence of English on the timetable, by teachers who may have visited Britain recently. Its efforts to re-introduce the "speak english only rule" in most secondary schools seems to have brought about few remarkable changes so far. Most students use English only under supervision, and when they step out of school, they immediately switch to Kiswahili or their other vernacular, when talking about familiar topics in a language every one else uses and understands. This is a complex problem addressed in many papers (For example, Msuya, & Mtui, 1987; Msemakweli et al, 1987) and is also discussed in Chapters 6 and 7. An attempt to discuss issues in the local environments during science teaching is thus hindered by students inability to translate complex phenomena they heard being discussed in another language. Too often, though, even this attempt to bring environmental issues into classes is rare among most teachers. As a result, biology, like other sciences, is a subject to be memorized and reproduced for examinations. In this study, students were not receptive to the efforts of Mrs. Maganga to use an enquiry focused teaching approach.

The structured lecture, examples and note copier.

This lecture/examples/notes approach to teaching/learning activities was characteristic of Mr. Mifano at School A. Mr. Mifano's brief life history was described in Chaper 4. Mifano believes that good teaching involves the selection of appropriate teaching/learning experiences and suitable and familiar examples to illustrate each concept. In the sense of Lucas' categorization of environmental education (Lucas, 1979), Mifano practices education in (from) the environment, although he rarely provided students with a hands-on practical experience. He does it mainly by lecturing and some questioning. A good instance was observed when he was explaining the difference between the endocrine and nervous systems. The nervous system was likened to a telephone distribution system which consisted of receivers, wires and an exchange station where the telephone messages are relayed from transmitter to receiver. The teacher made the point quite well that if there was no telephone exchange station, several people calling each other would interfere with each other and would not be able to communicate. In the nervous system, the job of the telephone exchange is done by the central nervous system, with some messages being relayed through the brain while others are relayed through the spinal cord. The endocrine system, on the other hand, worked rather like a radio transmission system, where one station transmits messages to a large area. The message can only be picked up by those in the area who happen to tune their radios to that transmitting frequency. In the case of the endocrine system, chemical messages (called hormones) are poured into the blood stream and will only be picked by certain target tissues, e.g. glands which are permeable to specific hormonal substances. This sounded like a practical analogy with examples rooted in the immediate environment of most students, and integrating in it some elements of physical science. The only problem was that this and most other examples came directly from the teacher (rather than from students through careful questioning or group discussions) , and secondly, most explanations were verbal, without involving any practical demonstration of the phenomena under discussion. As a result no question was asked by students during the above lesson. The teacher gave his example and explanation, writing a few key words on the chalkboard simultaneously, and finished his explanation by writing down a few notes for the students to record in their notebooks.

Other observed lessons were a combination of lectures and few simple classroom experiments performed by the teacher or students under the direction of the teacher. For example, before explaining accomodation in the eye, the teacher asked students to perform a simple experiment first.

> T. . . . .O.K. Put the tip of your pen or pencil very close to your eye and try to see it as clearly as possible. Move it slowly back and forth until it is clearly visible, then measure the distance between the tip and your eye.

Students did this for a few minutes, then the teacher began to use it to explain visual accommodation, short and long sightedness, and astigmatism. The students enjoyed the exercise but it seemed to the observer that the teacher did not challenge them to answer questions such as:

. At what distance the eye sees the tip most clearly;

. Whether the focal points (f) of different students are the same or different and why;

. Whether (f) for a person who wears reading glasses is the same- (1) when the glasses are on and (2) when the glasses are removed.

. Perhaps at home, try this experiment with one of their parents or grandparents who is over 60 and compare (f) for parent/grandparent and the children.

This might have enabled students to construct knowledge about eye defects. In this case, however, after the one experiment, the teacher went on talking and giving notes about accommodation, long/short sightedness and astigmatism. As a teacher, the observer wished that the students were given this challenge, even as an assignment, but they weren't. The teacher said later that his class was behind in the syllabus and so he had to rush them in order to complete the topic of sense organs quickly for an end-of-term examination. Moreover, this was an afternoon lesson (2.30-3.30 p.m) which had been reduced by 20 minutes, and he felt he had to rush things in order to complete as much as he would in the normal 80 minute time period.

In another lesson, Mr. Mifano was observed to give a demonstration involving one of the students. The topics of the lesson was,*The Spinal Cord* and *Reflex Action*. After drawing a cross section of the spinal cord on the board, the teacher wrote on the board, 'Reflex action'. Then he asked one of the students to go to the front of the class. The teacher brought a finger in front of the student's eye while every one in the class was watching. As expected the student blinked his eye and the lesson proceeded as follows:

T: Did you see what he did?

S: He closed his eye.

T: He 'blinked' is the correct word, and this is called 'blinking reflex'.

The teacher went on to give other examples of reflexes, such as touching fire et cetera, from which he later developed the concepts of reflex arc and synapse, writing notes on each after explaining each example. In the midst of the lesson, two interruptions occurred: late students entered twice, and a Chama Cha Mapinduzi (CCM) youth secretary entered to announce something on the preparation of posters to welcome Mr. Nelson Mandela who was visiting the city that week. Near the end of the lesson, the teacher tried to relate reflex action and thinking. Since most students appeared very passive, he suddenly switched the discussion into Kiswahili, the common language of the country.

T: Ukiambiwa, 'pigana', je utapigana? (If you were told to, 'fight", would you fight immediately?)

S: Utafikia kwanza, kwa nini nipigane. (You would first think, why the fighting.)

T: (to Student Rajabu) Ukichokozwa, ukapigwa, una-provoke reflex action, basi unapigana. (If you were assaulted and badly beaten, it might provoke a reflex action to fight back.)

Unaweza pia ukaacha kujibu huo uchokozi ukacheka, usipigane. (You might as well refuse to fight back the assault, and laugh at the other person, instead.)

Then the teacher switched into English.

T: Reflexes are meant to protect your body. If an insect gets into your eye, it will damage it. When you close the eye, you protect it (from damage).

A similar pattern went on during subsequent examples of conditioned reflexes, the autonomic nervous system, and other topic areas. It seems clear from the two excerpts above that this teacher supplements his lectures with daily student experiences in a subtle way. On many occassions he had to switch languages to enable students to participate in the discussion. However, unlike Mrs. Maganga, he employs limited questioning and provides limited opportunities for students to do practical work. He gave notes at the end of most lessons, to be copied into student notebooks, developing for many students the "bible" to be memorized for the midterm or other exams. Student motivation seemed low, since the teacher used the same style in teaching for almost every topic during the observation period. Student interest might have been increased if he had changed the venues of certain lessons, sometimes using the often empty laboratory, or short fieldtrips outside the classroom to make some pertinent observations. The teacher commented during an interview later that such approaches were feasible only in theory, but in practice, one was faced with so many obstacles and there was nothing more that teachers could do. He mentioned such obstacles as the reduced lesson times, the pressure of external examinations, and the fact that every one was doing things this way, some teachers were actually giving students materials to copy directly into their notebooks without any classroom discussions.

The copy-lecture copy (C-L-C) method

One of the teachers observed to use this methodology was a teacher at School B, Mrs. Chapuchapu. In one of the lessons observed, she gave a lengthy exposition on the topic of *Excretion* . At this time students listened quietly and obediently, without asking any questions. After about 25 minutes, she asked if there were any questions. The students had no questions because the lesson seemed to be taught so fast that students had little time to think of questions. The teacher herself had asked only one main question,

T: "What is excretion?"

S: Excretion is the removal of products of metabolism.

T: Any other definition?

S. Silence.

T. True. Excretion is.... and went on defining, explaining excretory products in man, their source and mode of removal from the body. At this time she was writing some words on the board and erasing them as soon as she could. "Notes will be given", she would sometimes reassure students. Thus students seemed anxiously waiting to "copy the facts."

When the teacher saw there were no questions, she was heard to say, "Then I am through. Now start copying the diagram from the board in your notebooks. Leave space for copying down notes." It appeared that both the teacher and students were tense, perhaps due to the presence of the observer. A student was chosen to copy the diagram from the teacher's notebook onto the chalkboard. The teacher walked around the class asking students, " mbona hamchori?" (why aren't you drawing ? (i.e referring to copying the diagram from the board into their note books). When she came to me (I was seated at the back of the class observing) she whispered, " Well you see I have finished. Unless you have something to say, we have finished." I replied that I was interested to see how the students were proceeding with the drawing, and would stay on untill the bell went. Twenty five minutes were used in drawing the diagram. (Most students finished drawing after ten minutes).

Leaving aside the problem of copying, leaving space for drawings and so forth, the lesson might have been taught differently through the use of models, dissection displays, or other teaching media so that students could see/observe kidneys and associated blood vessels, sweat glands on the skin, lungs, alveoli, and the like. Students would draw from these charts or their text books, encouraging them to read further and observe animal kidneys when they visit the butcher, and so on. When asked about this possibility the teacher said that there were no visuals in the school and books were unavailable. Reading the Annual School Inspector's Report later, I found the remark that there were many books in the schools' stores which were gathering dust but were not being distributed to the students. There was also a pond, a bird's cage and aquaria which were not utilized in teaching at all. Thus the argument that schools lack laboratory supplies or textbooks was in this case, not any excuse for the lack of practical activities nor the harnessing of the school environment for biology teaching. Since this teacher had only 5 years experience and had not received university education, it might be argued that university education would broaden her conception of biology education and the teaching of a science subject.

Another example of this approach was observed at School C as well. In a form 4 class observed on 3/4/90, the teacher Mr. Moyo, also the holder of a teaching diploma, was teaching the concept of *Growth* in animals. Out of the 80 minutes allocated to the class, the teacher used the first half to explain and ask students a few questions about growth patterns in animals , covering such concepts as "unlimited growth" (sic) in lobsters, fishes and reptiles, "step-like growth" in insects, and the process of metamorphosis and moulting in insects. During the remaining 40 minutes the teacher copied some notes from his notebook on the chalkboard for the students to copy into their note books. Like in the previous case in School B, the students seemed rather passive when the teacher was talking but became active when it came to copying from the board into their notebooks. These students were in their final year (form 4) and were preparing for the CSS Examination at the end of the year.

Three interesting points emerge from these two observations:

First, whatever the topic, these teachers use a similar style, namely, talk and chalk. Second, the tendency towards traditional teaching doesn't seem to be influenced by the teaching resources available within the school (such as books or other resources as is the case of School B), or even a rich school environment (as was the case at School C). During interviews, the teachers said that they had received training at teachers' colleges and nothing else. This was limited as most Diploma courses last only 2 years after form 6 (grade 13), and only a few things are taught in depth. Then exams were pressuring them to deliver as much as possible or else students would blame them if they encountered questions they had not learned in class. Third, whatever the environment within the school could offer, (for example models of kidneys, charts and other teaching media and the natural environment at School B, logs of trees showing annual rings and bark, a large variety of insects and amphibians at School C) the teachers never even referred to it. Thus, the teacher at School C, while talking at length about primary and secondary growth in plants, worked very hard illustrating shoot and root meristems, heartwood, cork formation and the like diagrammatically on an overhead transparency and the blackboard, (a rare skill among teachers observed in the study), but never brought in any specimens from outside the laboratory nor took students on a short field trip to see xylem, cork, dead wood etcetera on the abundant tree trunks and barks just outside the laboratory.

Participants' views on forces against the environmental approach

The previous section examined various factors influencing the teaching/ learning process in the schools of the sample. It is evident from that section that there were various social, economic and even political factors which make the teaching of biology at form 3 level a copy-copy exercise. Similar factors act against the introduction of environmental issues into the science curricula. This section reports the views of participants in the study (teachers, the curriculum developer and ministry administrators) on forces influencing the introduction of an environmental approach in the classroom. All participants agreed that the environmental component of the curriculum was relatively weak as was the experimental approach in the teaching of biology in general. In this section, the views of the participants at various levels are summarized.

UNEP Chief of Envronmental Education

The Chief Environmental Officer interviewed at the UNEP office thought that an EE movement was failing mainly due to the lack of goodwill by some governments to appoint competent personnel who could translate global U.N. policies into national objectives and develop teaching/ learning materials to reflect those objectives. When asked whether any countries they were working with had achieved any successes the Chief said:

> I would say Kenya has been successful. What they have done is to take our (U.N.) documents, e.g. Trends in EE since the Tbilisi Conference (1983), Procedures for developing an EE curriculum (1986), and others, and developed some booklets to be used as teaching/learning resources for primary and secondary schools in their country (Interview in Nairobi, 7 May, 1990). *3

There are signs that the ministries of Environment and Natural Resources and Education in Kenya have taken action in the right direction. In Tanzania, the National Environment Management Council (established in 1983) has a strong Act of Parliament stipulating its duties, which include:

- Formulating a policy on environmental management;
- Coordinating all bodies dealing with environmental matters;
- Evaluating existing and proposed (government) policies and advising the government on future policies and programs;
- Recommending measures to ensure that environmental impact assessments are done before projects are started;
- Fostering cooperation between the government, local authorities and other bodies engaged in environmental programs; and,
- Establishing and operating a system of documentation and dissemination of information relating to the environment (an educational role). (See Tanzania, 1984 p. 2).

A pollution officer who was briefly interviewed at the National Environment Management Council said that the Council works with the MOE on EE and has an officer at the MOE coordinating their educational activities. I learned later that the officer responsible for this was a retired officer who was working on contract terms, a different person from the EE Coordinator I had interviewed earlier. It was not possible to arrange an interview with this officer, hence it was not possible to know the role he was playing. This state of affairs led me make to the following inferences:

. The person(s) fully responsible for directing, and/or coordinating environmental education are not clearly known;

. The ministry lacks technical expertise on environmental education;

. Foreign donors, depending on their interests and financial position, provide some assistance here and there, but not in any way systematically addressing issues at the classroom level. I later talked to a land use planning officer, who said:

> . . . We have so many plans in this country which look wonderful on paper but very little practical action is being taken to implement them. This is very discouraging. (Interview, 28/3/90 in Dar es Salaam).

The Malihai Conservation Clubs

Malihai (From the Kiswahili Mali= Resources, Hai= Live) Clubs is a non profit and non political organization for conservation education in Tanzanian schools. It is concerned with promoting attitudes, education and awareness among the youth about the economic, cultural scientific and aesthetic values of natural resources, and promoting the spirit of conservation. Grown from its sister organizations of Kenya Wildlife Clubs and supported by various NGOs like UNEP, DANIDA and others, it attempts to promote conservation values in schools. During an interview its organizers indicated that they confined their work to wildlife conservation in Tanzania, rather than promoting the teaching of science as an understanding of the total environment. Moreover, their membership was optinal and dependent on teacher enthusiasm for science clubs, which was not widespread in the country. None of the schools in this study, for example, had an active branch of Malihai or any other science club.

The curriculum coordinator

A sub-regional training workshop on curriculum development in EE for Sub-Saharan Africa was held in Malawi in December 1987. The Curriculum Coordinator (Biology) interviewed for this study was among the participants. According to his report of the workshop, various recommendations were made for action by the Institute of Curriculum Development, (ICD) including:

a) That the ICD should re-examine the present school curricula with a view of strengthening the EE component;

b) That EE should be explicitly stated in the school curriculum, with emphasis on environmental concepts;

c) That training seminars should be conducted for curriculum developers, teachers, teacher trainers, and ministry of education/ ICD officials;

d) That an urgent national/ inter-ministerial seminar or workshop to sensitise policy makers on EE should be coordinated by the MOE;

e) That training seminars and writing workshops for teachers should follow, so that they can write their own materials. (Gunze, 1988, p. 2).

During an interview with the Biology Curriculum Coordinator, I asked him why none of these recommendations had been implemented so far. He indicated that there was a lack of direction from ministry administration:

> . . .The Ministry of Education has given neither the go-ahead nor any financial backing; we have only ended up in 'awareness creation seminars', no further follow-up has been done. As you know, we work on the priority areas defined by the MOE and the financial allocation we receive from them. If the Ministry doesn't support our activities, we cannot do much. (Interview, 15 March, 1990).

When asked what form it would take if the ministry gave the go-ahead, he said that it would probably take the form of "infused EE issues within the existing structure of the science curriculum" (namely the subject specific disciplines) at the secondary school level and above .

Students' recollections of past environmental learning experiences.

As far as the biology teachers in the study were concerned, students in the sample had varying recollections on their past treatment of environmental issues in their teaching of biology. The BLAC instrument, used for assessing this involvement, had 45 items of activities thought to relate biology to the local environment, for which each student was asked to respond whether their present or past teacher, or any other person had involved them in that kind of activity. The findings of the BLAC administration are presented in Tables 11-14 (Appendix I).

Overall, student responses indicated that for most of the instances on which they were they were involved with the activities in the checklist, it was with previous teachers rather than with the present (observed) ones. Present teachers and other people received relatively lower scores (See Table12, Appendix I)

An examination of the students' recollections of the BLAC activities will show that there were few instances where such activities were performed by their present or other past teachers.(see, for example, tables 12 and 13, Appendix I) The data do not show this very clearly, but raises questions which may be addressed in the future through interview s with students and teachers about the types of learning activities in which they involve themselves.

The students of Mrs. Chapuchapu and Mr. Moyo both indicated a less than 50% involvement in most activities in the BLAC questionnaire. (With the exception of a few activities for Mrs Chapuchapu, and one alone for Mr. Moyo). Activity 36 (working with biological models, put in the checklist mainly for comparison) appears to be the only activity most of the students in the whole sample had commonly experienced. This was observed in the lessons of Mrs. Maganga, Mr. Mifano and Mr. Moyo as teacher demonstrations of the working of organs using biological models. Some respondents recalled that these activities had been done with other teachers in the past. Some of these activities were supposed to be performed in the lower classes (such as forms 1 and 2, or primary school general science from grades 3 to 7). However, for most of the activities, there were doubts among students whether they had done them during their secondary school year. These data, however, need to be interpreted cautiously in the light of a possible random checking of items by some respondents.

Some learning activities had taken place outside the school system in a nonformal capacity. (See table 14, Appendix I). The recollection that some of the activities had been performed outside the school system existed among a number of students. Most activities in this category are those involving the communication of environmental information. Respondents indicated that they had worked on their own initiatives or with their siblings, friends or parents in such learning activities as: explaining behaviors of local animals, talking about things of biological interest at home, comparing the diets of their home with that of their classmates, discussing traditional methods of preserving food, brewing and the like, discussing treatment and disposal of sewage, or reading about organisms in other parts of the world. Responses in this category had an interesting pattern. Most students who responded positively in these activities were children of professional parents, followed by those of peasant or unemployed parents. (Table 14, Appendix I).

Summary of students' recollections

On the whole, the students' response pattern was rather unclear. Most students indicated that both their present teacher, other teachers and people (parents and close relatives and friends) had involved them in the learning activities of the checklist. Secondly, few activities scored high among present or past teachers, although there were activities reported to have been performed at all levels from primary to secondary school, in a variety of subjects, including general science, biology, chemistry or agricultural science. (Agricultural science is taught in Agricultural biased secondary schools such as School C). Thirdly, the role of non teachers in the learning activities was reflected in a few cases, and though only about 20% (or less) of the students indicated learning from this source, a wide range of nonformal contacts were listed, including, parents, friends or organized hobbies. Thus, there seems to be a combination of formal and non formal learning of environmental issues among the student sample. The rate of response to various forms of non formal learning is related to parental occupation, with children of professional parents responding the highest, followed by those of peasants or farmers.

Summary of the findings

Overall, the findings may be summarised as follows:
With regards to the perceptions of the participants about EE, there was a tendency for most of them to echo the official definitions of UNESCO/UNEP in their attempt to describe the meaning of environmental education. These definitions had been repeated in seminars, workshops and key briefs delivered by the UNEP chief, the national Biology Curriculum Coordinator, and the MOE official who was supposed to coordinate EE in schools and colleges. None of these definitions or briefs had examined the conceptual elements in the U.N. definition relevant to the curriculum orientation, classroom learning activities or supporting teaching and learning resources in the Tanzanian situation. No programs nor immediate plans of programs for EE in the biology curriculum were available. Teachers in the sample schools had not attended any workshops or seminars on EE, though there were statements in the objectives of biology education which indicated the desire to address human biology and environmental iassues. There was some variation on the level of teachers' awareness based on their level of education.

The content of observed biology lessons illustrated teaching styles which ranged from inquiry and persistent questioning, and requiring students to do some thinking about environmental experiences, to outright traditional expository teaching and copying of notes supplied by the teacher. More questioning and classroom demonstration was mostly observed in lessons taught by teachers who had received University education. These teachers also consulted a wider variety of textbooks, although none of the UNESCO publications were being used by any of the teachers. The two diploma teachers mainly taught by expository style, giving notes on the chalkboard. In all classrooms, there seemed to be a persistent problem of communication, with students mostly silent even when persistently asked questions on every day environmental phenomena. Some students, however, responded when questions were asked about concrete issues in the city, or when the teachers used the

Kiswahili medium of interaction rather than English. During interviews, most participants thought that EE was failing due to lack of a government support and monitoring machinery.

Students' recollections of involvement in learning activities of environmental nature indicated learning from their present (form 3) teachers, as well as other teachers in subjects such as Agricultural science and Geography, and others in non formal settings from people outside the school system (mainly parents, siblings and peers). Non formal involvement in environmental learning avtivities was reported more from children of professional parents and less from those whose parents were peasants or farmers.

NOTES

*[1] Several critiques of interpretation, implementation and execution of various aspects of Education for Self Reliance exist. The interested reader is referred to, among others, Nkonoki, 1978 & 1987; Pendaeli, 1979 & 1985; Cooksey.1986; King, 1985; Mosha, 1990).

Chapter 6

INTERPRETATION OF THE FINDINGS.

Introduction

In the previous chapter, I described classroom observations, interview responses and comments from teachers, the biology curriculum coordinator, ministry administrators and the chief of the U.N. environmental education section. In this chapter an attempt will be made to interpret these findings. The interpretation will address intentions versus ongoing curriculum, from the point of view of the U.N. environmentalist, ministry administrators and curriculum developers, and school teachers. The process of the social construction of classroom discourse will be discussed, including the forces acting on this construction in relation to the treatment of environmental issues.

The "intended" and the "on-going" curriculum.

There is, in curriculum development, a persistent problem relating to the fact that the aims and objectives of curriculum innovations are often not realized at the classroom level. Olson (1984) calls this the "dilemma of curriculum implementation." In the findings of this study, classroom observation and some of the interview data offers two revelations. First, whereas the intentions of the U.N. global experts were well stated in the U.N. plans of action (As in UNESCO, 1976, 1977), or in regional African Conferences (UNESCO,1978, 1987) and broadly in the school biology syllabus (Tanzania, 1976) these intentions were still far from entering the discourse of biology classes in the schools in the study. Classroom teachers claimed that the U.N. and other global rhetoric had not reached them, that they had no support by way of teaching materials or professional guidance , and that the present school routine and teaching program did not take into consideration any of the recommendations for the objectives of the UNESCO-UNEP plans. This raises the question as to who takes the responsibility of taking action when such "broad guidelines" have been laid down by global or national bodies. At the global level, the U.N. works through its experts in such offices as UNESCO, UNEP, and UNIDO, to develop ideas and materials which may be useful for educational purposes in either the formal or non formal sector. Countries which happen to have some of their experts hired by UNESCO in developing these materials may use such experts to adapt the global guidelines to suit their own school situations. A good example of this is the recent attempt by Alberta authorities to develop an Alberta Conservation Strategy modelled after the World Conservation Strategy (IUCN/WCS, 1980). However, as indicated by the U.N. chief during interview, when the material has been prepared, it is national ministers of education who are officially charged with the duty of disseminating it to the grassroot levels. In a bureaucratic system, ministers would then charge their desk officers and curriculum developers with the task of coordinating the translation of these goals to national objectives. In the case of Tanzania, it is not quite clear as to who is in charge of this task, although the official interviewed at the ministry of education indicated that he was partly responsible for coordinating the UNEP sponsored seminars during the last 3 years. As was learned at the National Environment Management Council, another person was expected to be responsible for this work. This person was unavailable for interview.

Even in these circumstances, there were positive things in the UNESCO-UNEP workshop reports. First, the workshops were held in various centers in the country each year and mainly involved teachers in Dodoma, Arusha and Moshi. Arusha and Moshi, situated in the North Eastern Highlands, have the largest number of secondary schools and it appears logical to hold sessions at these sites so as to involve as many teachers as possible. Dodoma is an environmentally sensitive region, with the driest climate and the worst gully erosion in Africa situated in Kondoa District in the region. Some of the forestation officers in the region, e.g. those working for *Hifadhi ya Ardhi Dodoma.*, (HADO- Dodoma Soil Conservation Project) took part in the seminar and presented papers on reforestation and land reclamation. Second, many burning environmental issues were addressed in these workshops, including afforestation and soil reclamation, wildlife conservation, energy issues and the like. These were, however, clouded by a low involvement of classroom teachers. Over 60% of the attendants of the first workshop (held in 1987) for example, were ministry administrators. School teachers and representatives of the teachers associations were a minority. An examination of the list of attenders at the other two workshops revealed that essentially the same people attended the second and third workshop except for the teachers who were still a minority. No teaching materials were produced from these workshops. Since the ministry did not budget any local funds to continue this exercise, talk of environmental issues in the science curriculum ended by listening to these speakers, without any concrete plans for action. Thus, like the policy of Education for Self Reliance, the curriculum response to the global call for EE was yet to be laid out.

Second, dissemination of information was slow. Teachers who did not participate in these workshops, like those in the study, knew nothing about the workshop proceedings. Many excellent papers which addressed national conservation issues as being appropriate for inclusion in secondary school biology and geography programs were not distributed to other school teachers. This, coupled with the pressure to produce good examination results, provides support for most teachers to concentrate on expository teaching with the belief that such approaches will effectively prepare their students for the examinations. Third, even such revolutionary teaching materials as the School Science Project, prepared and tested during the 1960s and designed to encourage local science investigations were rarely used when available in the school. One teacher noted making reference to them from time to time, but not with a view to adopting an enquiry philosophy. Others retreated to the safe position of expository teaching and rote copying. They were anxious to influence the lesson almost 100% acting either as "prime movers" (information giver), and assuming students to be sponges, or "navigators," controlling the direction and point of the lesson with little allowance for serious student participation (see Olson, 1981).

Copy-lecture-copy teaching. The teacher as prime mover, students as sponges.?

The literature indicates that a large number of teachers teach in this way in many parts of Africa (Komba & Temu 1987; Ugwu, 1980; Williams and Buseri, 1988 a & b). Williams & Buseri (1988) describe it as "expository teaching" characterized by "chalk and talk," with limited recourse to demonstration and pupil practical work. The main reasons given for this style are, among others, large class size, and inadequate resources (especially laboratory facilities). Mbilinyi (1979) accused every teacher in Tanzanian secondary schools as teaching this way, and called it the 'copy-copy method'. She used this terminology to describe a method which would be expected to be commonly used by the untrained teacher more than anyone professionally educated in a teachers college. The teacher identifies a good reference book at the beginning of his/her career, and copies the most useful points of his/her lessons into a notebook (called the lesson notes book). For each lesson the teacher selects a section of the lesson notes and gives a lecture for 20-30 minutes. Most students sit passively listening; usually no questions are asked. The teacher then announces that it's time to copy notes. The students who had appeared to lose interest again become active. They are now copying the "facts" originally copied by the teacher from his/her "secret book." A question or two on a word that can't be read properly, or what certain words mean are the only types of questions. In such a system the teacher's most valuable asset are the notes and the book from which she/he prepares the lesson notes. Should anyone take these away, the teacher will have to postpone a few lessons and search for the book and notes. When some students know the source book that is being used by the teacher, they will either give him/her a "hard time" by reading it and then asking questions on future topics, or correct errors which were made when the teacher prepared the lecture notes. It seems that most inexperienced teachers are often the victims of such student challenges. Such teachers tend to be very authoritarian and tend to feel uncomfortable when students ask questions about the real world around the school or city, which may be different from the textbook writer's world.

As noted earlier, the non graduate diploma teachers fell mainly in this category. The diploma teachers' complaint that they received no professional support after certification underscores the need for better professional development workshops. This means that a re -examination of the Diploma teacher education program is necessary, as well as organizing more inservice programs for all science teachers on the environmental approach and what Olson (1981) calls "low influence teaching."

Given these realities on the EE workshops and the classroom teachers' position, the intentions of the environmental emphasis, laid down since the Belgrade charter, (UNESCO, 1976) Tbilisi and other U.N. forums, had not reached the teachers in the study in a form in which they could be achieved in biology teaching. Neither had the teachers' organizations taken up those goals and broken them down into teaching objectives achievable at the classroom level. According to the national coordinator of biology curriculum development, the Institute of Curriculum Development has been waiting for the Ministry of Education to provide financial backing for the development of teaching materials. Meanwhile the ministry coordinator for EE workshops was looking for funds to research the status of EE nationwide. Teachers continue their wait for directions on EE.

This constant tug-of-war between policies or goals and their implementation at the grassroot level has been the central problem of new curriculum innovations in science education. It occurs in the literature in various scenarios. New curriculum goals, such as the Inquiry Teaching "revolution" of the 1960s, were welcomed with several new curricula, including BSCS, Nuffield Sciences, the School Science Project (SSP) of East Africa and so forth. However, when those materials were ready, pioneer groups of teachers went enthusiastically to implement them in trial schools but their enthusiasm was not shared with other teachers in schools which weren't part of the pioneer team. As Marten Shipman wrote in reference to the Keele Integrated Science Project:

> Every innovation requires more skill from teachers than conventional subject-based class teaching. The pioneers and the enthusiasts they attract can make the innovations work, can produce the results that make the early evaluation positive, and can serve as a seedbed for its spread elsewhere. But the *spread* involves increasing numbers of teachers who lack the skills and the enthusiasm of the pioneers. The promotion aspects of involvement in an innovation are also rapidly exhausted and the ambitious soon look to the next bandwagon. The result is that an apparently successful innovation in the hands of a few can fail when generally adopted and diluted. (Shipman, 1974, p. 177, emphasis added).

It is also unfortunate that the environmental emphasis has not even attracted serious "pioneers" in Tanzania, as indicated by the interviews with curriculum developers and the ministry coordinator. The coordinator did not have any specific strategies for encouraging teachers. Thus, the pioneering work of the U.N. expert team has been received with little enthusiasm in Tanzania. The goals stated in the Belgrade Charter remain untranslated into achievable objectives by curriculum developers in the Tanzanian situation. Teachers are, therefore, left with open ended goals of teaching biology such as "knowing ourselves and our environment" but without specific guidelines and materials as to how much should be known about "ourselves" and "our environment" and how might such knowledge be achieved. At the time of this study, a "New biology syllabus" (Ministry of Education, 1988) had been prepared for distribution by the Ministry of Education. It had nothing to help the teacher make use of local resources and environment. Instead, it only suggested a rearrangement of topics and added further content to the "O level" biology program. Such changes made it more difficult for teachers to promote achievement of the broad environmental awareness goals.

When Olson (1981) studied teachers involved in the British Schools' Council Integrated Science Project (SCISP), he observed various problems despite SCISP's carefully designed materials to "guide the teacher." The teachers saw the new "enquiry approach" as threatening to their authority and classroom influence, and the integrated science teaching commitment built into SCISP as unfamiliar and risky to teach. They also believed that it would not succeed in preparing students for the "A level" examination. In this study, it was found that the environmental emphasis, requiring an integrated approach, had neither the instructional materials to support the content nor the "low influence teaching" methodology necessary to promote its success. Such realities as teachers with limited subject background and professional education as well as a system that emphasizes results on external tests as a measure of teacher effectiveness were not in favour of an environmental approach in Tanzania. Thus, when intentions are expressed through such global movements, as global education, environmental or peace education, their interpretations and implementation into classroom discourse need much more time and effort than often assumed. The Ministry of Education (MOE) remains unsure of the forms in which EE will be introduced in the school curriculum.

Global EE desires and efforts

The efforts of global organizations in promoting or encouraging EE can be viewed in two ways, namely,

1) Global organizations working within the U.N. system, including UNESCO, UNEP, United Nations Development Program (UNDP) and the like;

2) Multilateral and bilateral aid organizations, e.g. Swedish International Development Agency, (SIDA), Canadian International Development Agency (CIDA) and corresponding organizations like, DANIDA (Danish), USAID (United States), FINNIDA (Finnish), OXFAM (British) etcetera.

Not all these organizations are solely interested in environmental issues, or have experts on environmental matters. Some are merely involved in the "Business of AID" , and their knowledge of the intricacies of curriculum implementation discussed above is limited. Even at the scientific level, they need some time to acclimatize to the tropical weather and understand the socioeconomic and political contexts of such environmental issues as desert encroachment, dynamite fishing, deforestation, soil erosion and loss of fertility, or rainfall reliability; phenomena which many of the people involved in such organizations may not have personally experienced. There are many environmental problems in Africa which are endemic to the continent due to its position across the equator. Some are explained geographically, others biologically, geologically, or sociologically. The local people whose past generations have survived in the area for centuries have knowledge of the cycles of events and even some of the causes. There is a danger in the arrogance of so called global experts who are often unwilling to consult with local scientists, let alone, peasants on the possible solutions of ecological problems. They proceed like the traditional medicineman, who asks the patient to remain silent while he juggles a 'black box' to diagnose the "misfortune." While he can on occasion be correct, this approach remains guesswork and unproductive. Recent use of western educated local experts has not changed their mentality. There is a fear that once local scientists are on the payroll of multilateral organizations, they tend to do things which satisfy their contractual arrangement in order to be sought for future consultations. Sometimes the environment is put at risk. Anyone working for a global organization is thought to be knowledgeable, and the extensive reports and prescriptions they write are often used uncritically by governments of most developing countries for fear of losing donor support. The detrimental effects of past prescriptions are evident since the colonial days from the disastrous groundnut scheme in central Tanganyika in the 1940s to the failed waterhole schemes at such places as Talamai and Mfereji (in Masailand) which drained large amounts of hard earned foreign currency to pay for the "aid packages" (Parkipuny, 1976). To this may be added the whole cash crop policy imposed during the colonial days and still being "subsidized" by multilateral organizations such as the European Eonomic Community (EEC) that requires farmers to produce crops and have no say on their pricing.

The people had resisted the growth of cash crops for a long time, but without much support from their government, which threatened to put anyone who refused to grow cash crops into prison for "sabotaging the country's source of foreign earnings." These sad effects have now encroached into education. The management of both the environment and EE from the outside is a subject which troubles the minds of many Africans. Part of this crisis is addressed in Ogunniyi, (1986) and Jegede et al. (1989), who strongly suggest that Africans may have to rewrite most of their science textbooks to suit the cultural and environmental issues facing the continent. This discussion, however does not imply that global efforts have been totally unsuccessful. In some countries (e.g. Kenya) some success in the development of environmental programs appears to be in sight. This was learned during an interview with the U.N. chief of EE, based in Nairobi. Teaching materials have been developed on a broad conservation education basis. I don't know whether there are any plans to infuse EE into the traditional sciences. The operation of UNESCO & UNEP provides a good example of an organization supporting environmental management and education in Tanzania.

The role of UNESCO/ UNEP Africa.

The United Nations' organizations operate on the principles of the U.N. charter. They draw on the expertise of scientists and other personnel to generate and compile knowledge about various global environmental problems on the globe.In Africa, the FAO, UNEP, UNCOD, UNIDO, UNESCO, WWF, IUCN, UNDP etcetera all work in various countries and at various levels (UNEP and UNESCO are the two organizations examined in this study). Since the U.N. global call for EE at Tbilisi in 1977, the only thing which appears to have been done in Tanzania was the adding of a statement to the objectives of biology education at the secondary school level; "Biology is about knowing ourselves and our environment," with no interpretation as to what this means. Since the Tbilisi conference, the U.N. system (mainly UNESCO and UNEP) have produced a series of materials for teaching and general information for teachers, politicians and the public at large. Some of the publications are appropriate for design of environmentally focused science curricula. (See Table 15, Appendix I).

Tanzanian scientists have at times been involved as part of the U.N. think tank- however, after outlining a course of action these people are not obliged to promote or even suggest its use in the school system. The U.N. system is not allowed to interfere in the internal affairs of any sovereign state. Therefore, even if good proposals and resources are produced and a country does not use them, no action is possible within the U.N. Charter. As such, it is not surprising that the first seminar on EE for secondary schools in Tanzania was conducted in 1988, 10 years after the Dakar recommendations for EE in Africa (See UNESCO, 1978). None of these materials were available for teachers or educators in the ministry of education, even though the ministry must have been supplied with enough copies as indicated by the U.N. chief. Reports of any local EE workshops conducted since 1988 could not be found. In the light of this state of affairs, it appears unlikely to find teachers being very enthusiastic about EE. Secondly, teacher educators in Tanzania, especially in Diploma Colleges, have not addressed EE issues with student teachers in their preparation for environmentally oriented science teaching. None of the teachers in the study recalled any part of their teacher education program which promoted environmental education. The anxiety of the UNEP Chief of EE therefore, seemed justified.

> . . . We make use of experts, produce the materials we can, and hope that each country will adapt to suit their school system. (Interview, Nairobi, 7 May, 1990).

If a country could monitor the development and use of EE materials, then it might increase its chances in the development of environmental literacy. Evidence from the 3 schools in this study indicate a complete lack of such monitoring.

Ministry of Education position on EE.

There is a common attribution of statements made by certain officers at the ministry headquarters as "ministry policy." However, statements coming from the ministry can be considered as official ministry policy only if they are backed by ministerial circulars or standing orders. Official policy is communicated to schools through ministerial circulars. Effective implementation of such policies can be monitored by the ministry through school inspectors or the research department, which in Tanzania is called the Coordinating Unit for Research and Evaluation (CURE). With regards to the adoption and implementation of EE goals, the ministry of education has not as yet issued any specific circular. The Institute of Curriculum Development (ICD), which develops school curricula, cannot act to develop teaching /learning resources if there is neither a ministerial circular nor an allocation of funds. These are the problems of a decentralized system, where institutions function on orders from above. This was clearly expressed during an interview with the Coordinator of Biology curriculum development based at the ICD. Verbal statements by the president or ministers of education about "teaching about environmental protection" mean little if there are no official guidelines to enforce them, no specific individuals accountable for their implementation, and limited financial and professional backing to support them. Such was the situation in Tanzania at the time of this study.

When UNEP provided some funding to run environmental awareness seminars , it was the ministry officials who supervised the seminars, including ministry headquarters' personnel as both the main resource people as well as audience. When the UNEP funds were depleted they did not budget for local funds to continue the work, and did not assign its relevant organs (ICD, Universities, Research institutes, etcetera.) to work out the technicalities of a sound EE program. They waited for more UNEP financial support. One might question the commitment of the top ministry people to EE. Why did they not mobilize local expertise to develop teacher and student materials for EE? Local and enthusiastic expertise on environmental issues is available in a number of institutions. Some of these institutions have expertise of international recognition (See Table 16).

The absence of a formal ministerial circular to emphasize EE indicates that the ministry of education has not yet considered EE as a curriculum priority. The ministry official in charge of EE indicated that he was searching for more funds from external sources to conduct more studies on the state of environmental education in schools and teachers colleges. The state of EE within the subject of biology has been summarized in the 1989 Annual School Inspection Reports (prepared by the School Inspectors) in all zones in the country. The Inspection Report for the Eastern zone, where this study was conducted, indicates that most teachers in the zone were unclear about syllabus

syllabus changes which had not reached most schools but which were rumored would be examined by the national exams at the end of the year. On careful examination, there is basically no difference between the new syllabus and the old one in terms of emphasis, there are only changes in topic arrangement. The School Inspectors' report further identifies the fact that only 2 schools in the zone had science clubs. Teaching is described as "theoretical", "lecture mode", "with class participation minimal", "failure to utilize labs" etcetera. These indicate expository teaching which was further confirmed during this study by both the classroom observations, teacher interviews and BLAC student questionnaire. The inspectors recommend "good methods of teaching", revival of clubs, regular marking of student notebooks issuing text books, and procurement of laboratory supplies.

These recommendations have various implications for the promotion of an environmental approach in biology and other science subjects. First, the "good methods" of teaching, implied in the School Inspectors recommendations were listed as including such things as the revival of science clubs, and marking of notebooks, implying that the students must perform certain tasks on their own and get constant feedback from their teachers. Another recommendation was on the use of existing resources such as ponds and aquaria in biology teaching. These recommendations, though quite practical, are only kept in ministry files. Since inspectors reports are not accessible to school teachers or the general public, the implementation of their recommendations may take years of bureaucratic file dancing.

The ministry attitude towards the Science Teachers Association of the United Republic of Tanzania (STAURT) is another interesting issue to examine. STAURT has existed since the late 1960s when curriculum innovations such as SSP, SMP, and APSP were active. The decline of these revolutionary curriculum projects in Africa has been examined by Lillis & Lowe (1987); Yoloye & Bajah, (1985), and for Tanzania, by Pendaeli, (1985). Pendaeli sums up all the failures of past curriculum innovations as resulting from the "problems of underdevelopment." During the period of this study, STAURT (which survives due to the hard work and dedication of a small group of teachers in the schools in Dar es Salaam) organized a science fair event for the city secondary schools at Azania Secondary School, and requested the Ministry of Education to provide moral and material support.

Table 16: Selected Tanzanian institutions with environmental expertise.

Institution	Professional expertise	Areas of specialization
1.Mweka Wildlife College.	.Wildlife ecology .Animal behavior Management	.Taxonomy of flora & fauna .Conservation .Wildlife management, etcetera.
2.Forestry Research Stations.	.Forest ecology/management .Soil science .Botany	.Forest Management
3. Fisheries Research Institutes.	.Fresh water, marine & fish ecology(seas, lakes and rivers)	.Marine environment .Coral reef ecology, etcetera. .Fish production in seas, Life in lakes & rivers
the 4. Ministry of lands. Natural Resources and Tourism.	Sewage and City Dumps, &. Surveying and Mapping Environmental Manage ment.	.Land utilization .Urban & rural planning & management
5. National Environment Management Council.	.Environmental Experts (engineers, ecologists,	Environmental Impact Ass. .Rules & Regulations, etcetera. chemists,etcetera.)
6. Ministry of Agriculture.	.Agricultural growth and marketing	.Agr. extension service, .Fertilizer Storage, & marketing
7. Universities.	.Life Sciences, medicine, .Engineering, agricultural .Physical Sciences, etcetera	.Teaching, Research & Consultation experience in all sectors.
8. Institute of Curriculum Development.	.Curriculum Developers & Subject specialists	.Design of Curriculum Proposals and teaching & learning materials

They provided little financial support and sent one official to open the fair. The official came on his own, without being accompanied by even the EE coordinator or school inspectors. Nor was there anybody from the City Education Office. This lack of effective official representation indicates that this event was not considered as a very important occassion. The science teachers who attended had been excited to see the return of student projects being supported, but they foungd no strong official or parental support. Many left earlier than they had wished and asked their students to dismantle their projects almost immediately after being judged without showing them to the public. Some students seemed extremely keen. Although there was only one biology and 9 physical science exhibitions, there were more than 12 mathematics exhibitions. As I visited the exhibits I recognized a deterioration in the calibre of projects from those which existed in the 1970s. Most exhibits presented traditional textbook experiments rather than creative research into locally relevant science related phenomena. Various factors may be associated with this deterioration. The identification of such factors and their impact on the motivation of science teachers and the social reconstruction of classroom discourse is the subject of the next section.

The social construction of classroom discourse

In the previous section I have tried to show how the intended curriculum goals (sometimes termed, Curriculum as Prescription (CAP), see Goodson, 1989) of environmental education remained a myth in the schools I studied. The notion that high powered prescriptions would encourage teacher utilizations of environmental experiences in biology teaching has been found to be a totally false assumption. In the literature, this is reflected in various forms.

First, the very notion of teaching to EE goals is essentially a process of interpretation. As Schutz (1959) would argue, the biology teacher is involved in a complex process of construction, negotiation and re-negotiation of the meanings of curriculum, science, and biology in his/her classroom. The main actors in this negotiation process may interact at two levels. At the primary level, the teacher is facing his/her students, who have several problems, including those of language, lack of textbooks, an overcrowded school curriculum (students taking up to 10 subjects), unreliable transportation to and from school and several others (See chapter 5). This negotiation was revealed in two ways during the teacher interviews.

One, students see most teachers as teaching "to the examination", and examination success is the most highly rewarded achievement in school. The examination mainly demands recall and comprehension of information (Brown & Njabili, 1989). Thus, students feel comfortable with teachers who give as much information as possible which is useful for doing well on this type of examination. That includes notes for copying and memorizing, and extra coaching or private tuition. Form three students know very well that the national exam they sat at the end of form two and the forth coming Certificate of Secondary Education Examination (CSEE) at the end of form 4 have an important role to play in their future. Performance in the latter determines entry to form 5 and possibly the chance to enter directly into university or other prestigious post secondary institutions in pursuit of diplomas and degrees. These qualifications become the cultural capital to be traded for jobs. Mrs. Maganga seemed to experience discipline problems by insisting that her students design their own experiments or make their own observations- activities that students would not perceive as being helpful to them in achieving high examination grades. This teacher, who had just returned from advanced educational studies, thought she had reconstructed her meaning of teaching, but the tension with student expectations and desires was forcing her to return to the status quo.

Two, the head of the biology department in School A defended what she called "hali halisi" (the real world) of biology teaching as opposed to university rhetoric on enquiry teaching or environmental emphases. She defended the former on the grounds of maintaining student interest in the subject as well as collegial uniformity. Thus, according to the department head, a teacher who wanted to change was in danger of being isolated by colleagues in the department as well as the students in his/her charge. Mrs. Maganga was further frustrated in that her head of department had locked up most of the modern equipment donated to the school. Towards the end of April, Mrs. Maganga attended a meeting in Arusha where she represented her school in a conference organized by donor agencies which were funding the renovation of the school buildings and teaching facilities. The meeting was attended by representatives from other schools which were receiving similar assistance, and included heads of schools and administrators from the Ministry of Education. She complained that during the meeting, representatives of the donor agency in question wanted more feedback from the teachers on how the renovations were going to facilitate teaching and learning. However, teachers were rarely permitted to speak up. Ministry bureaucrats and heads of schools dominated the discussion, demonstrating their disregard for professional opinion from the teachers, which they thought might reveal some of their internal contradictions. Mrs. Maganga's frustration was revealed during our final interview:

> . . . " I don't know when teachers will have the opportunity to be heard on the problems they are facing when implementing the curriculum. Our administrators seem to be too eager to control everything, leaving the teachers helpless and unmotivated to innovate. . . . " (Interview, 5 May, 1990).

Thus, both at the primary negotiation process (classroom and department) and secondary negotiation (at the meeting, or with the researcher) there were several problems. The reality of Mrs Maganga in school A described above reveals the myth that curriculum prescription can control teaching and learning in classrooms. This analysis may apply to the situation in the other schools as well. Teachers who stuck to the status quo were the most comfortable; those who desired to change the teaching style in favour of increased student involvement were forced to retreat to the status quo.

Student response to the activity checklist revealed a more or less equal representation of learning activities they had done with present teachers, parents and previous teachers. Mrs. Maganga was perceived by most of her students as involving them the least in most of the BLAC activities. It is not clear why this teacher was so perceived, when it is considered that she asked very challenging questions and brought in biological models when teaching the Nervous System and other topics. It is possible that while using much of the time asking questions, she forgot to get the students to learn by doing; or, when she asked them to design their own experiments, she may have over estimated their ability and gave little direction and guidance. In a sense, the students' opinions corresponded to that of her head of department:

> Teachers who make their students do a lot of work, be it answering questions or designing investigations are (generally) hated by the students (in this school)" (Interview, Head of Biology, School A, 28/2/90).

In a discussion with this teacher, it was obvious that she believed that she was doing the right thing but felt isolated in her efforts. Her head of department did not appear to support inquiry teaching, and most of the other teachers who taught by a "copy copy" routine reflected the department heads' views. Mrs. Maganga was trying to reconstruct her meaning of teaching and learning following her recent advanced educational studies. However, she had to think seriously on how to fit into a school where few of the other members of staff shared her views. She found refuge in sensing that I was smpathetic to her belief that teaching biology was more than "spoon feeding." For her, teaching was helping people learn independently by encouraging them to ask questions about observed phenomena, and critically appraising their beliefs and interpretations.

The impact of socioeconomic factors on teacher motivation

A number of socio economic factors have been responsible for the low performance of education and other sectors in Tanzania since independence. They have affected the supply of qualified science graduates and science teachers (Nkonoki, 1987), the availability of teaching and learning resources, including textbooks, laboratory facilities (Chonjo, 1980, Meena, 1979). In addition, teacher motivation has been eroded because of very low incomes and poor living conditions. The growth of science graduates, school enrollment, government expenditure in education and science teacher incomes was described in Chapter 1 (See Tables 1-5).

A teacher now earning T. Shillings 8,000/- monthly (Approximately U.S. $ 40.00) after 20 years of service, is less motivated than a counterpart who chose another profession and earns much more elsewhere along with several fringe benefits such as the use of a company or government vehicle, entertainment allowance and better housing. During this study, this situation was confirmed by the relatively low proportions of graduate teachers left in the schools, and by the reports of zonal school inspectors on the decreasing graduate teacher population particularly in government schools. According to the 1989 Eastern Zone Inspection Report, for example, there were 110 biology teachers in the zone that year, out of whom only 41 were university graduates (5 of whom had degrees). Of the remaining, 64 were diploma teachers and 5 were direct form 6 (grade 13) leavers who had not undergone any formal teacher education at all. During interviews, one long serving graduate expressed the desire to quit teaching as soon as a better job was available either in or outside the field of education in the country or in neighboring states.

> . . . Most experienced teachers with whom we left college together have quit (teaching). We are left with diploma teachers mainly, and their competence, given their education level, is low. Some of them are so young (referring to Mkwawa Teacher's College graduates) they are a discipline problem in the school. Was I to get a job elsewhere, I also would quit. I am still here only because I haven't found anywhere better to go. (Interview, School A, March, 1990).

As reported in the findings, most teachers had to find other sources of income to supplement their low pay. One teacher described what he does after school:

> . . . I have a 2 hour private tuition class tonight, for example. Every one has. I charge them per hour, and I can make up to 12,000/- a month, which is over twice my government salary. On weekends, I weed my cassava plot which supplements my food bill. (School B, 28 March, 1990).

This underscores the point that the demands on an environmental approach on such a teacher are not likely to be heeded. For such a teacher wouldn't have the time to do the preparation required. The observed expository teaching and note copying rush during normal class hours, therefore, is rooted in this complex array of problems, or "circumstances" (Vitta 1978), or "problems of under-development" (Pendaeli, 1985). Official reports of School Inspectors also describe these problems in their files. A 1989 Inspection report for western zone revealed that:

> . . . Due to lack of well planned learning activities, lessons appeared imaginary and unmotivating to pupils. . . . (p.2).

and:

> . . . there were very few occasions when teachers directed pupils into practical experiences. Subject clubs had not been initiated. . . . (p. 3).

These reports corroborate the findings of this study. As indicated earlier, the observed classroom practice has been constructed from years of direct experience of these teachers themselves, accompanied by a lack of support to do things differently. The goals and objectives of the environmental education movement are irrelevant to teachers who are struggling in such circumstances. Thus, the recommendations of U.N. and ministry officials have become rhetoric and have not gained entry into the classroom.

THE ROLE OF LANGUAGE

Language is such an important socio cultural factor in education that it deserves a separate discussion. An environmental approach to biology education might require students to articulate their daily nature observations and insights on their home, school and other surroundings, and reflect on their biological significance. It would also entail critical discussions on traditional technology and philosophy, reflecting on what these can teach us today. In the presentation of the findings, I described how form 3 teachers faced difficulties in discussing biological issues in class because student participation was negligible when the teacher persisted in using the mandatory English medium of instruction. The students were apparently uncomfortable using English language, perhaps afraid of making mistakes and unable to express the subtleties of the arguments.

In my discussion of historical and political factors I also noted that British colonialism introduced English as a medium of instruction in the secondary schools. There is a continuing debate on the appropriate medium of instruction in secondary schools in Tanzania, dating as far back as the mid 1960s when the ESR policy was first proclaimed. Kiswahili was declared the medium of instruction in primary schools in 1965. Since then, many books have been written in Kiswahili for science teaching, and more are in the process of being developed. The details of the language debate in Africa in general and Tanzania in particular are beyond the scope of this discussion, but it needs to be pointed out here that the use of a foreign language as a medium of classroom interaction is such a serious problem that it may be considered to be the greatest contributor to the present crisis in African education. The Tanzanian situation is often viewed as easier to handle due to the existence of Kiswahili as the lingua franca (See Polome, 1982) but the evidence of the stagnant state of classroom interaction at secondary school level (especially after all primary education was in Kiswahili) affirms that the language of instruction remains a serious problem.

Most children speak their mother tongue and pick up Kiswahili in primary school and through the mass media. By the time they enter secondary school, most children are fluent in Kiswahili, and can read the literature available in this language at their level. They will also have acquired the basics of most concepts (including environmental) in this new language. Local mass media operates mainly in Kiswahili, so the children have various opportunities to develop their Kiswahili language skills. Most rural children, however, can communicate with their parents and the older generation only in the mother tongue (there are over 120 different mother tongues in Tanzania). Thus access to traditional knowledge is only through the mother tongue. After grasping Kiswahili, those who enter secondary school are faced with an English language medium. Though they have had 8 hours a week English lessons from grade 3 to 7, because they don't often use the language outside these classes, their level of proficiency is very low. Politically, it is argued that the purpose of elementary education is not to raise the English proficiency of the students; its main purpose is to make them literate and numerate in Kiswahili, the national language, and give them basic skills of survival. This sounds logical in a developing country with few resources to provide universal secondary education, but the change to English in secondary school problematizes the fulfilling of the other objective (to produce local experts who can think critically and interact at the international level).

The language crisis is therefore a crisis of the secondary school system desiring to maintain the language standards set for the colonial secondary school curriculum for a very different historical period. When students enter Form 1 (grade 8) they have to relearn the English equivalents of all technical terminology they had almost mastered in Kiswahili at the end of primary school. Many children (except the highly talented), who have predominantly operated in Kiswahili during their 7 years of primary education, are unable to become fluent in English at the same time. This change in the medium of instruction into English at the secondary school level, therefore, creates many difficulties in classrooms, some of which were observed in this study and were discussed in chapter 5. It might be recalled how Mrs Maganga (School A) experienced silence from her constant questions framed in English, and how Mr. Mifano who had similar problems but, after using some Kiswahili, was able to receive student input in his lesson on Reflexes. The Ministry of Education keeps insisting that

English be used as a medium of instruction even though they know from recent examination results and inspectors reports that low proficiency in the language is a serious hindrance to students in expressing their views. Diploma teachers, many of whom are unable to communicate well in English, must teach in it. As a result, they either talk very little in class and copy textual information on the chalkboard, or attempt a discussion in a mixed language, and then copy notes on the chalkboard in English (Both Mrs. Chapuchapu's lesson on "Excretion" and Mr. Moyo's lesson on "Metamorphosis" illustrated this approach). Teachers who insist in using English only end up talking to themselves, with very little student input. Sometimes students might give an answer to a different question from the one asked by the teacher, or utter a misconception, which may pass unnoticed by the teacher. In one of Mrs. Maganga's lessons on "Drowning", for example, a student called out that when you drown, "Your stomach also gets too big because you drink too much water." To which the teacher responded, "Yes, when gasping for air." Actually, the whole body gets big (not only the stomach), and not just because you drink the water, but because the cells absorb water due to osmosis. The teacher let this pass uncorrected, possibly losing an opportunity to correct a misconception. How could such approaches to teaching create an awareness and a better understanding of environmental problems?. How could they encourage students to examine, in a holistic sense, environmental issues at local, national, regional or global level, or discuss the solutions to a local problem?

Language, thinking and talking

The role of language in the development of thought has been extensively researched by Vygotsky (1934), and Luria (1959, 1961). These studies have revealed that children internalize language in a way which makes them become self regulating systems rather than passive respondents of stimuli. Language helps understand what things are as well as what they might be. As Lawton (1978) notes, our view of reality is bound up with the language we have acquired.

The students view of reality in this case was partly constructed in their vernacular language, developed in primary school in the Kiswahili language and then, at the secondary school level, attempts are made to consolidate it in English. There is a possibility that a large proportion of the students view classroom discussions as remote, difficult and unclear. The long periods of student silence in the classes observed seem to reflect a lack of understanding.

Yet, when a teacher switches to Kiswahili, some responses to questions are immediate. BLAC responses also indicated that non formal learning contributed largely in the activities involving verbal communication.

The role of Kiswahili and other vernaculars is increasingly becoming the subject of research in Eastern Africa. In a recent study, Abangi & Cleighton (1990) found that Kenyan primary school teachers "face difficulties using English when pressed for spontaneous language use ", as well as when required to make complex explanations of scientific concepts that have little or no equivalence in the students vernaculars. They further suggest that foreign curricula impose on Kenyan teachers :"the duty of dual translation-both *linguistic* and *cultural* - in order to establish meaning" (p.69, emphasis added). Similar problems are reported in India (Kulkarni, 1990). These are similar to the problems faced by all the teachers in this study, and, like the Kenyan teachers, most of them mix English and the vernacular (Kiswahili in this case) in the classroom interaction, though all notes are recorded in English. The problem of "translation" referred to here is not confined to children like those in Kenya, Tanzania or India, for whom English is a second language. As the literature on misconceptions in science teaching unfolds, more evidence shows that even for children where English is their first language, the language of the science class which is often technical and arcane poses similar problems (Fensham, 1990, Solomon, 1988). When students are unable to talk freely about what is being taught, their ability to correctly conceptualize the issues at stake is greatly reduced.

Environmental issues are best learned by talking about the local environmental relevance of the concepts being learned. Discussions about familiar issues promotes a clarity of thinking and provides opportunities for increased understanding. In this study students neither spoke to each other nor to their teacher about the topic being taught, or any aspect of the biological world around them. The language crisis can not, therefore, be separated from the crisis of science teaching and hence of environmental education in Tanzania.

PERCEIVED FORCES INFLUENCING CLASSROOM DISCOURSE OF ENVIRONMENTAL ISSUES

Any discussion on forces influencing observed behavior requires a deeper examination than a mere description of classroom observations. This is not always easy because each observer will construe events differently from other observers, depending on previous preconceptions and theoretical assumptions on the phenomena under observation. In this discussion, the researcher's predisposition is that of a biology teacher and educator who has experienced similar situations in the same country, albeit in different school environments. The forces discussed here were synthesised from the interviews, observations and student questionnaire data, and are historically treated. This section will report an effort to answer questions such as: Why do teachers teach the way they were observed to teach? What forces influenced them to not use the school environment and students' past experiences? In the previous section a teacher was described who used questioning techniques to encourage students to think and participate, another who asked few questions but alternated lecturing and "copy-copy" technique, and those whose classes were characterized by a brief, rushed expository followed by long periods of "copy-copy." Various forces appear to influence the way these teachers taught, and during interviews most teachers said that they couldn't teach any differently.

Originally, I had thought that the location of a school would have a substantial influence on what went on in its classrooms. During the whole time of observation in the schools there was little evidence of school location influencing classroom biology teaching. Differences in teaching style seemed to be attributed more to other factors such as the teachers' level of academic and professional education, teaching experience, and professional support as argued by Beeby,(1980). Moreover, like Sagness (1970) I found that most teachers were not prepared to work in any specific environmental setting, neither did any program exist at pre- or in-service level to sensitize them of the potential of their specific school environment for teaching biology or other sciences. Various other factors made them unable to explore this on their own. However, developing programs to assist them in their situation was being considered at the ministry level though nothing had actually been done at the time. As I studied my field notes and interview transcripts, I noted that the following were among the forces influencing a teacher's choice to use environmental issues in the teaching/learning activities.

(1) Level of academic/pedagogical education

The level of academic education and professional experience in general suggested more influence on the teaching style than location of the school or availability of facilities such as laboratories, green houses and the like. For example at school A, two teachers who had completed a similar length of professional experience taught their form 3 classes in relatively different ways. One of them had earned a Master of Education degree recently and seemed more inclined to include child centered approaches to teaching and learning, encouraging students to design their own experiments, take down their own notes, and so forth. To do this effectively, students needed reliable textbooks or worksheets designed for this type of learning style. The lack of such a 'student guide' combined with the fact that this teacher was acting alone made her work difficult. When asked, "think of an experiment that you want to do on this topic and see me to discuss it before you start", students shyed away from this practical activity till the topic was completed. At the time it seemed to create more problems for the teacher than did the lecture-copy method of her colleague. Over the long term, however, it might have been more beneficial to the construction of the meaning of science, if students took it seriously. The teacher changed her style in her next topic and brought in models, and other visuals to show students the various structures of the nervous system. Unlike this teacher, her colleague used less visuals, and more chalkboard notes for the students to copy into their notebooks. The extra 2 years of M.Ed degree may have contributed to the use of more student centered approaches by the other teacher.

The other two teachers, (school B and C) used the typical "copy-copy" style. Teacher talk continued for a maximum of 25 minutes. This was followed by notes copied from the teachers notebook onto the chalkboard and from the chalkboard into student notebooks; a scenario that Freire (1973) would call the "banking approach." During interviews, diploma teachers defended their styles as the only method they knew and that other styles were not familiar to them. Their level of academic/ pedagogical education was a factor they thought limited their teaching style[1].

> . . . Our academic horizon remains limited. Unless one reads on his/her own, the only knowledge one has for teaching is what one got from school and the teacher's diploma course. There are no seminars to widen one's horizon." (Interview, Mrs. Chapuchapu, 1 May, 1990).

Mrs. Chapuchapu expressed the benefit she got by participating in a panel to mark the National Certificate of Secondary Education (CSE 'O-level') examination. She said that when she was selected for the task two years ago, it was a great opportunity to meet other teachers, exchange ideas and see new perspectives of teaching as they marked the exam questions. She was able to compare standards between schools and appreciate common problems shared by different teachers. There are many teachers who have been in classrooms for a long time without having the opportunity to sit down and reflect about their work with colleagues. The more ambitious diploma teachers prefer to apply for university entry, but admission requirements sometimes turn them down because of their lower A-level or diploma performances. When they know they can't be accepted, they become upset and can't teach effectively.

(2) Teacher transfer.

Transferring teachers from one part of the country to another has been a ministry policy for decades. It appears to be characteristic of any bureaucratic centralized system. Ministry officials give various reasons for this practice. One, due to teacher shortage in some schools created by resignation, expulsion or retirement, it is sometimes necessary to fill vacancies by transferring teachers from schools where they are in excess. This applies to government schools which are centrally administered.[2] Two, a ministerial circular recommends that teachers should change stations shortly after being in one location for five years. As a result, teachers are transferred every now and then to work in different schools during their teaching career. There is often no choice for the teacher, and even though the ministry pays a "disturbance allowance", the losses of their belongings caused by movement in the poorly maintained transport network are rarely recovered. This ministry philosophy has various implications for an environmental approach to teaching. Very often teachers are removed from an environment they have understood quite well, have made friends in the local community and are familiar with suitable sites for field work activities, and forced to move to new, unfamiliar parts of the country, where professional and personal adjustment may be difficult. It may take a teacher several years to understand the biology and ecology of various organisms, and other interesting examples suitable for teaching, as well as the resource people available and willing to help teachers within a particular location. Thus this ministry policy doesn't appear to favour a science teaching grounded on the environmental approach.

Three, sometimes a teacher is transferred at the request of the headmaster, whatever the reason. When teachers feel they don't like the new station and it is being forced on them, they may resign their positions and take up jobs which ensure that they can settle down in one location and establish a more predictable future. Few teachers request to be transferred, except from unpopular or remote schools to better managed ones, agriculturally more prosperous places or closer to their home districts. Moreover, rarely are such requests accepted unless one has the "right connections." Of the teachers in the study, two (Mrs. Maganga and Mr. Mifano) had taught in only two schools during their 13 year careers, and they seemed to have worked only within the Dar es Salaam region. These may be considered lucky when compared with Mrs. Chapuchapu (school B) who had taught in three previous schools, School B being her fourth, over a five year career. School B was a well equipped school according to the 1989 School Inspectors Report, with aquaria, animal cages, and the local fish market only 15 minutes walk away, but the available resources had never been used in the program by this or any other teacher in the school. Many books were "locked in cupboards and not distributed to pupils." (School Inspectors Report, MOE, 1988, on file). Instead, students were being made to copy teacher prepared notes most of the time. It can be inferred that when a teacher experiences two or more transfers in a career of less than 10 years, he/she may never get the chance to develop a thorough understanding of the school environment for teaching purposes. Coupled with the lack of any professional support at the district level, they may resort to the copy-copy method. They may use the same teaching notes for many years without revising them. Opportunities to relate biological concepts to the living world in the immediate proximity of the school are left unused. At the end of a career, the extent of professional experience is likely to be quite limited.

(3) School administration pressures

Transfers of headmasters to school environments they know little about may prove even more disastrous to the school programs than the transfer of classroom teachers. Directed by the pressure of an authoritarian ministry, they may create less positive experiences for teachers and students. Some of the new heads appointed or transferred in this manner have sometimes led to massive resignations of teachers, apathy, and various forms of misunderstandings that affect classroom practice. In one of the schools chosen for this study, one experienced teacher resigned due to reasons described as a combination of unfair treatment by ministry administrators and to what the teacher described as poor school administration, blamed on the headmaster.

Headmasters were, as expected, very protective of their positions. During the study, one headmaster urged the researcher to ensure that his study was "within the school routine." Another one requested the "researcher's opinion" on the performance of the teacher being observed and to act as an evaluator. I had to make it clear that this was a research study and ethically it couldn't be used as an evaluation. There were attempts to tell the researcher to "report the truth only" without exaggeration, to be "like a teacher and not a reporter." According to one headmaster, some reporters were biased and sometimes got the facts totally wrong. One reporter wrote in a Daily News column that a serious poultry disease had broken out at School C and killed most of the school chickens, when in fact the school kept no poultry.

(4) Teacher remuneration

Although the salaries of teachers in general were raised 4 years ago following recommendations of the Nsekela Commission, they remain meagre by Tanzanian living standards. A first year teacher with a B.Sc or B.Ed. degree employed in a government school netted around T. Shs. 22880/- (About U.S $ 120.00) per annum in 1989 (Tables 4 & 5). This is hardly sufficient for a single teacher to survive 2 weeks in a city where the cost of living is as high as in any western city, and inflation is running at approximately 30%. Most teachers, therefore, work part time running private tuition classes, gardening, petty trading and so forth to make ends meet. Teachers running a part time class after school hours normally need to reserve energy for the part-time, often higher paying job. Low pay has, therefore, greatly reduced the quality of work in many institutions in Tanzania, like it has in any system based on low pay scales and bureaucratic control of its work force. The teacher who resigned from teaching during the study complained bitterly about low pay and was confident that he would earn much more by boosting the family fishing business in Tanga. Most of the best teachers have quit government service and joined the private schools, where they can earn up to twice as much for the same kind of work and still supplement this by part-time activities. It is not surprising to find that private schools and seminaries now produce better examination results than most government schools, even though the latter enroll the most capable primary school leavers after the Primary School Leaving Examination (PSLE).

The ministry has also lost many of its best science teachers to industry, parastatal organizations, colleges of higher education and what Joel Samoff (1989, p.3) has called, "the informal sector" (e.g. fishing). In a recent review of the education sector in Tanzania, UNESCO (1989) remarks:

> . . . The ministry (of education) does not attract the best manpower to education.

Thus, while efforts to introduce an environmental approach in biology (and other innovations in science) teaching appear to be strongly expressed at the policy level, they are poorly demonstrated at the classroom level.

(5) General management and timetabling.

The management of schools can have a great impact on certain styles of teaching. Here, management does not just imply whether the style of school leadership is democratic, authoritarian or laissez faire, but includes things like the size of schools in relation to existing teaching facilities, as well as the organization of sessions. A recent directive in the city of Dar es Salaam ordered all city schools to operate double sessions, morning (7.40 a.m to 1.30 p.m) and afternoon session (1.30 to 6.00 p.m). This has increased the number of streams at School A for example, from 6 to 12 in form 1 to 3 in 1990 and the trend will reach form 4 in 1991. The morning session is slightly longer, with classes lasting 40 minutes each, while in the afternoon session lessons last 35 minutes each. Since most biology lessons are double lessons, the afternoon classes are 10 minutes shorter. The late afternoon lesson is particularly problematic for students and teachers. Students are tired after a hot lunch in the hot, humid weather, and teachers are determined to complete the content that they would complete in the 80 minute morning lesson. The teachers rush, tending to lecture, avoid questions and questioning, delimit field trips and laboratory activities. The afternoon sessions are more vulnerable to reduction of student involvement.

The management of the two sessions varies slightly between school. For example, in one school it had been decided that some classes are permanently during the morning session while others are during the afternoon session throughout the term. For those on a permanent afternoon session schedule,the problems of this time of the day will be present throughout the school year. The energy of the morning wears out as afternoon approaches. There is a persistent impact on available time for study. Teachers in the double session schools condemned the afternoon session as most inconvenient for both teachers and students. They claimed that the last period was seldom finished because it was already late in the evening and most students, worried about missing their transport home, asked to be excused early to catch buses for home. The City Council has arranged for buses to collect students in the evening, but the buses are not always on schedule. Students fear they might be left behind and have to walk home in the dark, in a dangerous inner city environment. This is particularly frightening for girls. Thus, efforts to manage schools on a two session program in the city have been quite difficult for school administrators.

(6) Reading materials available to teachers

Textbooks in use by biology teachers in the participant schools were commonly found to be at least 10 years old. In a survey of the four teachers in the study, it was revealed that choice of a variety of reference books was related to each teacher's level of education and professional experience (see table 17). Three observations may be made:

(1) The two graduate teachers tended to list more reference books, with the M.Ed graduate listing 2 books not commonly found in the schools. She said that she consulted those and other books for reference in her lesson preparations. Compared to the diploma teachers, this speaks of the need for teachers to

become familiar with other sources of reference materials and professional development experiences.

(2) It was difficult to determine the references used for specific lessons, but I saw a variation of reference book preference as I sat near the desk of the teachers before the beginning of lessons. Reflecting on the teachers' use of references, one may distinguish between two roles for a text. Some texts act as guides to the process of scientific inquiry - essentially helping teachers develop questions which will be posed to learners so that they can together develop biological concepts. Others are used as a repository of knowledge to be copied, repeated, and recopied in students notebooks for rehearsal in anticipation of testing situations.

(3) No environmentally focused literature from UNESCO-UNEP or other sources was found to be used by any of the teachers in this study.

Table 17: Books used by teachers as texts and reference materials.

Author and	Title	Publisher	T1	T2	T3	T4 (*1)
Mackean, D. G	Introduction to Biology:	Longmans	•	•	•	•
Stone & Cozens	New Bio. for Tropical Schools:		•	•	•	•
Beckett, B.S	Biology: A modern introduction			•		•
Murphy, B.A	Biology		•			
Pereira, S & Ramalighan, T	Modern Biology		•			
Carolla & Rikline,T	Biology		•			
Hall, B.S	Senior Tropical Biology			•		
School Science Project (SSP).	SSP Biology (East Africa)			•		
Savory		Senior Biology		•		

[*1] NOTE:

T1= Mrs. Maganga	(School A)
T2= Mr. Mifano	(School A)
T3= Mrs. Chapuchapu	(School B)
T4= Mr. Moyo	(School C)

(7) Laboratory facilities

Numerous studies have confirmed a lack of facilities for laboratory experiences in secondary schools throughout Sub Saharan Africa (Meena, 1979; Chonjo, 1980; Nabudere, 1983; Kaino, 1988; Adamu, 1989). The situations in the schools in this study were not as desperate as some described in such studies, especially in the biological science area. However, due to the doubling of enrollment during the creation of double sessions, one laboratory and an untrained technician can hardly satisfy the requirements of 10 teachers, if all of them wished to promote laboratory focused programs. The laboratory at School A, for example, has limited facilities that are only capable of supporting teacher demonstrations, if they are supplemented by resources from the surrounding environment. For the 12-weeks during which I visited the schools, there was not a single form 3 lesson which was conducted in the laboratory. However, when teachers addressed topics such as Excretion, experiments or observations of breathing, the structure of lungs and kidneys, or the composition of urine were some aspects of the study which could involve practical work. In addressing a topic such as Coordination in plants, simple studies on plant response to water, gravity, light, and touch could be done practically by the teacher or the students themselves. Even the structure and function of the nervous systems of animals might be better understood through experimentation and field observation. All these topics, however,were studied in the classrooms through lectures and the copying of notes.

Some laboratories had complete dissecting kits, live animals could be obtained freely on request from certain government laboratories (e.g the Central Pathology Laboratory in Temeke gave laboratory mice upon request to those in need) or schools could breed their own animals at a relatively low cost. Thus, the usual complaint that one couldn't teach biology practically because there were no laboratory facilities at all was, from my point of view, uwarranted The schools in this study had laboratories and necessary equipment to support practical experiences relevant to the topics being studied. Some schools, like School A, recently received plenty of supplies, including overhead projectors, and other equipment, which could allow for a diversification of teaching/learning activities. These, however were locked in cupboards by the authorities for fear that 'they might be damaged'. In the trial school, the lab was turned into a temporary store to keep a considerable amount of equipment donated by a supporting country. The resigning teacher was the only one seriously devoted to unpack, store and, if he had stayed, probably encourage other teachers to use it. Since he quit, one doubts if any one is making serious use of it in science teaching.

Thus, it appeared that the presence of laboratory facilities had little influence on the amount of practical work in a school if teacher expertise and attitudes are not in favour of enquiry teaching. This problem has existed in school science education since the 1960s (Shipman, 1974; Olson, 1981). In East Africa, the demise of the School Science Project (SSP) was due to, apart from political pressures,the difficulty of diffusing the enthusiasm of the pioneer teachers throughout the school system (Pendaeli, 1985; Lillis & Lowe, 1987).

(8) Examination pressures

Examinations and testing procedures are a pressure on teaching and learning in most education systems. In Tanzania, one of the recommendations of the 1984 Presidential Commission on Education was that, since "education standards had fallen sharply" exams must be introduced at all grades to "motivate students to study harder." National exams now exist in grade 4, and 7, at the primary school level, and forms 2, 4 and 6 at the secondary level. One need not underplay the impact of these exams on meaningful learning. Most teachers are worried that if they approach biology teaching environmentally and experimentally they will not do justice for the students who have to write externally developed exams. Even though the students in the classes under observation would not be writing the external examinations for another two years, the teachers had already begun to "teach to the exam," which for many meant giving as many facts as possible. This worry about external exams was the major agenda for the biology teachers present at a regional Science Teachers Association (STAURT) meeting. Rather than discuss issues such as interesting environmental teaching/learning activities, or teaching facilities available in certain places in the city, or strategies for promoting environmentally focused student projects etcetera, teachers wanted:

> . . . more clarification on what topics will be examined at form 2 this year, in the light of the movement of some topics from form 2

> to 4 and so forth in the new curriculum guide. (Field notes, from the biology teachers' group taken during STAURT meeting 28 March, 1990).

Thus, unless a completely new approach to science teaching is reflected in policy examinations and teacher education, exams will continue to be "the tail that wags the dog."

(9) "Problems of underdevelopment"

A school like School A, had no school transport. As a result, teachers had many difficulties performing tasks such as the collection of specimens, identification of potential field trip sites, and contacting appropriate resource personnel. Given an understanding school administration, such problems might be partly solved by recommending the use of some of the Self Reliance fund generated from students' self help scheme, to finance the collection of teaching /learning materials, support educational field trips and the like. A study by Njabili (1979) indicated that this was far from easy. Management of the money generated by students in these projects is often the subject of great tension between headmasters who want to have the final say in determining the allocation of such funds, and the students who work in the projects. In a review of various failures in implementing well defined previous policies, Pendaeli (1985) asserts asserts that, even existing funds and equipment are not being adequately utilized for the purpose for which they were made available these are the problems of many developing nations which have inherited administrative structures from other systems which were at a different levelof political and economic development. While an injection of financial and other resources is greatly required, the development of better local management styles and attitudes is equally important in the empowerment of grassroot support groups.

NOTES

1. Of course, there is need to examine the Diploma in Education being offered by the colleges of education in Tanzania. Some educators wonder whether the curriculum is sufficient training for a secondary school teacher who may be

asked to teach up to form 4 level, while his/her highest academic education is only form 6. Moreover, there are two categories of diplomas, the Mkwawa Teachers College Diploma is basically a 3 year course following form 4 education, while the other diploma is a 2 year course following form 6, making it 4 years education after form 4. A University of Dar es Salaam evaluation showed that in the education degree program, there was no signifiant difference in performance between direct (form 6) entrants and ex diploma mature students, whatever their field experience. One head of department interviewed in school A claimed that Mkwawa graduates were "relatively raw and less mature" as teachers. Since most science teachers were diploma graduates, the impact of their presence on the teaching of science cannot be ignored. A study is in progress (S.A Mshana, personal communication, April, 1991) on the effectiveness of the diploma course and might shed some light on the problem.

2. Private schools, which now outnumber government schools almost 2 to 1 are also affected, but for other reasons, and also less severely than the latter.

3. See, for example, Kenya, (1987), Environmental Activities for Schools and Colleges in Kenya , among other publications of the Kenya National Environment Secretariat. This 23 page booklet contains suggestions for practical activities which create and promote environmental awareness. It covers activities such as debates on sustainable development and conservation topics, etcetera; lectures and talks, teaching media, field trips, newsletter preparation, establishing tree nurseries, school farms, and so forth. It doesn't indicate whether these activities are infusible in the existing science curriculum or whether they are designed for school/youth hobbies and clubs.

Chapter 7

CONCLUSIONS AND IMPLICATIONS FOR TEACHING AND LEARNING

Summary of the conclusions

The purpose of this study was to explore the factors influencing the teaching of biological science in the context of the environmental issues around schools and the global goal of EE. The study was conducted in the context of Tanzanian school form 3 classes, and focused on teachers' interpretations and teaching of the present biology syllabus in the context of the school environment, and the guidelines of UNESCO and UNEP. Data was collected through classroom observations, a student questionnaire, analysis of reports and documents, and interviews with teachers, curriculum developers, educational administrators and senior environmental officers (UNEP and local). Five main research questions were addressed relating to: conceptions of the participants on EE; the environmental content of form 3 biology lessons; resources available for teaching/learning environmental issues at the form 3 level; forces perceived to influence the teaching and learning of environmental issues; the views of participants on those forces, and students' perceptions of biology learning activities in and out of school.

The findings indicate that while EE curriculum policy at the global and to some extent, national (MOE) level share the UNESCO-UNEP conceptions as declared in the Belgrade Charter (UNESCO, 1976); biology teachers awareness of the objectives seem low, and their teaching, which is mainly expository, does not relate content to local materials or global environmental issues. The knowledge of biological processes on local school environments and the local community (implying a social reconstruction role of curriculum, See Eisner et al., 1974, Goodson, 1989) seems of secondary importance in form 3 classes, while rote learning and copying of text book content (implying curriculum as academic rationalism) seem to be the main concern of most teachers and their students. This approach is encouraged by the national examinations set at two year intervals of secondary education studies. Teachers lack teaching materials designed to focus on local environmental issues. Resource personnel in environmental institutions in the country have, at present, little to do with promotion of EE in schools, due to a general lack of ministerial guidance and commitment with regard to EE. Other problems such as inefficiency, poverty, ignorance, and lack of initiative are also evident in this lack of commitment to environmental education.

Outside the classroom there are various socioeconomic factors hindering EE emphasis in biology teaching. At the forefront is a lack of what Freire would call a "problem posing approach" in teaching, aimed at emphasizing knowledge generation for the purpose of self emancipation and liberation through a better understanding of our world. Instead, the method used perpetuate a "banking approach." The banking approach assumes knowledge to be "out there" (in books, traditions, or foreign experts) to be acquired, memorized, and reproduced in examination situations. The environment is conceived as a warehouse to be harvested and plundered. The heritage of British Colonial education has remained unchanged in secondary school science classrooms despite the rhetoric of radical educational policies. There seems to be a conflict of values and philosophies between western and traditional epistemologies, and a belief among some Tanzanian educational administrators that change must be supported by foreign donors has added to the feeling of helplessness in confronting the issues from a local perspective. Together, these forces have made it difficult for teachers to access environmentally focused teaching materials and professional development programs.

In a study in the U.S., Sagness (1970) found the locality of a school to influence teachers' choice of environmental issues for classroom discussion purposes. Thus, long serving urban teachers had different approaches to the same topic from teachers in the rural suburbs, each adapting content to resources in the surrounding environment. This study indicated that there was little difference in teacher attitudes and practices on environmental issues or environmental action whether the school was located in the city center or in the suburbs. The level of academic and professional education of teachers appears to influence their attitude towards teaching and the meaning of environmental education. From the evidence of this study, it seems that the higher the pedagogical education, the higher the interest in involving students in experimentation or discussion relating to local issues. However, school pressures forced teachers who were interested in experimental and environmental approaches to conform to the status quo of expository teaching. Such pressures included the tendency by most teachers to give notes for students to copy, and the rule to use an English medium of instruction even though most students do not understand English well. Expository teaching prevailed in the classroom presentations, where teachers used a few local examples and provided extensive notes. Diagrams were put on the chalkboard by the teacher to be copied in student notebooks. Memorization of class notes for tests and exams followed. The concern about understanding the environment, developing cognitive and process skills is not apparent. Most teachers interviewed were more concerned about their welfare and lack of handy teaching resources.

Implications of the findings for teaching and learning in Tanzania

The findings of this study concur with those of Meena, (1979), and Nkonoki, (1976); and William & Buseri (1988 a and b); and Onocha et al. (1990). The point made by these studies is that science education implemented during the post-colonial era retains the values inherited from the colonial system. The difficulty of changing past classroom practices relates to the barriers described in chapter 6 (Summarized in Table 18). The implications that can be extracted from the findings of this study for Tanzanian secondary school science programs can be directed at four main areas.

a). Setting of EE goals and objectives;
b). Development and distribution of new teaching materials;
c). The social construction of classroom reality; and,
d). The role of global NGOs.

Setting EE goals and objectives

One realization through this study is that regardless of the source of externally developed curriculum goals and objectives, there is no guarantee that they will be achieved or even addressed during classroom teaching-learning activities. The schools in the sample were located in the nation's capital and hence close to the very decision making body which received the materials prepared by UNESCO-UNEP shortly after they were produced in 1978. It seems likely that they would have been publicized in the capital city schools including the schools that participated in this study. However, there are various barriers at every stage, from the formulation of the objectives to their communication to the various levels in a bureaucratic system before they can be implemented at the classroom level. Table 18 shows the barriers which could undermine efforts of developing and implementing environmental education in the school curriculum.

In this study, materials developed by UNESCO-UNEP were left with the Ministry of Education without requiring curriculum developers to translate them into teachable guidelines in a Tanzanian context. In Tanzania's centralized system, the development of a new curriculum can only begin after an official directive and financial support from the Ministry of Education. It must be added, however, that directives and funds may not be enough; a curriculum coordination committee is needed to examine the goals of EE from UNEP and UNESCO, translate them into a local context, and recommend the needs of local curriculum change after a thorough needs assessment. In this case, the needs assessment would require opinions of teachers and other educators, ecologists, and conservationists. Tough educational decisions would have to be made, in response to such questions as the following:

. Should environmental issues be taught in the existing separate subjects or be part of a newly developed integrated science subject? (The latter would require a program for teacher education to be developed along with the teaching materials)

. How much EE would be in the core curriculum and how much would be in the elective portions of courses?

. What approaches might be appropriate to prepare teachers, (e.g. in-service workshops and seminars, or pre-service education arrangements)?

. What role would existing school teachers play in the design and development of teaching materials?

. How might student achievement be determined so as to support the use of activities that allow students to study relevant local environmental issues and problems?

. What role would be played by the non-formal education sector?

Table 18: Some barriers to the implementation of EE in the school curriculum.

Process/Effort	Barrier
(a) Defining an Environmental problem	Different levels of knowledge of the problem exist among different interest groups e.g. scientists/educators, North, South, investors vs consumers, et cetera. Compromise definitions of problems made, as in the Belgrade Charter, Bruntland report, et cetera.
(b) Knowledge of the nature of the problem	Group interests lead to differences in causes/ effects, possible solutions, evidence, credibility, communication between groups et cetera.
(c) Generating solutions (technological/ecological)	Economic, social and political barriers, e.g. of the technology, willingness to pay, to the problem, educational measures necessary, and so forth.
(d) Development of objectives of a relevant curriculum at all levels	Interest groups' conflicting social/economic interests, dominant interests or imposed traditional, colonial/neocolonial, and nationalist epistemologies, leaning theory affiliations, philosophy of science, etcetera.
(e) Design and development of teaching materials-books for teachers and students, pamphlets and educational media & technology, by adapting U.N. and other materials to local conditions.	Insufficient knowledge of local issues due to few studies,limits of centralized curriculum design, the role of pioneer teachers/curriculum developers.
(f) Try out, evaluation (formative and summative) and revision of teaching materials	Availability of funds, educational ~~expertise~~, time and political will.
(g) Teacher preparation	Changing old thinking, motivation of teachers and students, ownership (of programs and materials), resource materials and personnel, commitment of pioneers, et cetera.
(h) Classroom presentation	Reconstruction of the previous curriculum, addressing issues of student resistance, parental, peer and examination pressures availability of teaching resources, teacher motivation, school administration, timetabling, etcetera).
(i) Further evaluation and improvement	Teacher cooperation,administrative and financial support,cooperation of local scientists and environmentalists.

. What should be done about the medium of instruction in secondary schools?

Development and distribution of new school materials

Among the major barriers to the success of new curriculum initiatives is the lack of innovative curriculum materials (Rhoton, 1990), as well as a lack of appropriate teaching skills which is evident across the teaching force (Olson, 1981). The findings from this study suggest that if any increase in the teaching of environmental issues is to be expected, appropriate teaching materials must be developed, and a pioneer group of teachers identified and involved from the beginning. The pioneer teachers need to be involved in the development and promotion of appropriate teaching aproaches which are acceptable to the rest of the teaching force. In Olson's study, pioneers were highly enthusiastic but faced the obstacle of colleagues who had constructed the teacher's role as that of a "prime mover" or "navigator" and students role as that of "sponges" (Olson, 1981 p.168). The "progressive" teacher in this study (Mrs. Maganga) had serious difficulties with other teachers, students and even her head of department because she was trying to pioneer on her own.

One way in which her efforts might have been supported is through her becoming involved with other teachers in the design and development of new materials and in the appraisal and revision of teaching approaches. This could be accomplished through professional development workshops in each zone, so that either each zone could produce its own texts (teachers guides and pupil texts), or, teachers' groups from each zone could work on developing specific units which focus on the local environment and its issues. Such units could contribute to the development of a national text, or a series of texts. Eastern Zone teachers, for example, could develop a unit on the use of the rich marine environment, featuring the biology of its unique fauna and flora and the impact of pollution, and other human activities on such a delicate environment. Various learning activities could be developed and suggestions for student projects in this area could be made.

Similar work could be done in other unique ecosystems throughout the country. This would produce enough initial materials and as students continue to work with their teachers on different science projects, new knowledge could be added to the units or the units might be revised. Environmentally focused units could similarly be integrated into geography, physical science and other subject areas. The most important thing is that teachers must be encouraged and supported in their participation in the workshops and seminars, rather than involve long serving bureaucrats and senior teachers alone. First year teachers, especially diploma teachers, should be involved as much as possible alongside curriculum experts and experienced teachers in the design of materials in small groups, so that they increase their professional knowledge through direct practical work rather than wait until admitted into university for a degree course. This partial decentralization of curriculum development might increase teacher participation and hopefully increase teacher awareness of the local environmental issues which could become part of the school biology program.

The importation of foreign curriculum materials can continue, but these must be adapted to local conditions or used as resources in the development of environmentally oriented local curricula. The task of developing a science dictionary at the Baraza la Kiswahili la Taifa (BAKITA) (National Kiswahili (language) Council) and the Institute of Kiswahili Research should continue. Key science teachers in each zone should be involved in the process so that they can have their input and take back every new development to their respective zonal curriculum committees. As the classroom observations in this study revealed, it seems pointless to continue to enforce an English-only medium of instruction in the secondary schools at the expense of understanding science issues that affect the local communities. The present language barrier will only continue to stifle the development of national talent in the sciences, since there is evidence that most students fail examinations due to language difficulties. If the Chinese, the Koreans, Malaysians, Japanese, and Indians have managed to produce first class scientists and technologists in their own languages, I don't see why Tanzanians should cling to a foreign language while we have the advantage of a popular lingua franca. [1]

The implications for this will mean a "Swahilization" of the medium of instruction in post secondary institutions in the long run, with problems of staffing, books, and so forth. Experimental research on the use of Kiswahili in higher institutions needs to be conducted, so that the problems of using the language at this level may be explored in small groups before a full scale entry into the Kiswahili medium. The findings of such studies would help determine the viability of the long term use of Kiswahili in science teaching. Those in favour of perpetuating English may argue that Tanzanian scientists will not be internationally recognized, cannot communicate with fellow experts at global level and so on. First, it is not being suggested to get rid of foreign languages in Tanzania. English should continue to be taught as a second language and remain compulsory at all levels. Other languages now being taught may also continue. The concern here is about the use of a foreign language as a medium of classroom interaction. Educators in Tanzania need to think about the majority of students who are unable to benefit from science discussions, who are citizens of a deteriorating environment but are being denied of an opportunity to articulate the environmental issues of their communities. The few who get to the top can always express their knowledge if they have constructed it well, and with remedial English language programs they should be able to catch up. The process would take a long time, but I believe it would be worthwhile. Children would be able to talk about science and discuss its social relevance in the classroom as well as in their homes.

The social construction of classroom reality

The findings in this study seem to imply that if an environmental emphasis is to be achieved, a fresh look at the current construction of knowledge in the classrooms is necessary. These observations apply to the schools in the sample, but the reports of the school inspectors and the ministry interview data seem to suggest that the observed classroom processes exist in other schools as well.

Lewin (1990, p. 3) describes post colonial science education in African countries as an "elite preserve of alien knowledge, the practical values of which were not close to the experience of most of the population." This statement supports the view that the present Eurocentric philosophy of science education in Africa is contradictory to much of traditional thought, and unless efforts are made to "go beyond the tacit framework of science and science teaching" (Ogawa, 1990), the transition from a "traditional" to a modern society is likely to be long and painful for most rural Africans. African traditional knowledge and values continue to influence children's ideas of science concepts (Odhiambo, 1973, Ogunniyi, 1988). Likewise, the influence of western science has had such an impact that it cannot be ignored either. Beeby (1966, 1980) has argued for a long time that the transition of any educational system towards a stage of "meaning" faces political, socio-cultural, and financial difficulties. The main challenge is to modernise the econony and the social institutions while retaining the best traditions of the old society. In Tanzania, ideas for achieving these objectives were put forward in the Education for Self Reliance policy developed since 1967. Hence if the curriculum of biology or other science subjects is to be designed to prepare the child for future life, several options exist and, teachers must provide opportunities for all options to grow. To seriously involve students in environmental discussions; a process approach with a focus on increased student involvement might be useful in providing opportunities to address urban and rural environmental issues in biology classes. But, in order to have the greatest impact, the issues must be relevant to the pupils. Such issues would relate to their immediate surroundings including the surrounding of the school itself. In a large city like Dar es Salaam, several opportunities to study the biology of local communities exist. Given basic teaching-learning resources, teachers could get pupils to identify, clarify, discuss, observe and explain biological issues of the sea shore (basic biology of the organisms, ecological relationships, human impact, such as pollution by ships and sewage and good and bad fishing practices). In the inner city zone, far from the direct exposure of the sea, the focus could be on the biology of city garden plants, ecological interrelationship of the plants, humans and pets and the management of sewage, garbage and the like. In the suburbs, the issues might include the biology of selected local flora and fauna, ecological relationships, and the impact of human activities such as cultivation, animal husbandry et cetera.

One problem will be to choose among integrated, coordinated, modular or balanced science approaches (Black, 1982; Frey, 1989) and a subject specific approach. In spite of growing evidence that most environmental and technological issues are multidisciplinary, and the fact that African traditional thought is mainly holistic, it may be difficult to switch to a radical integrated science program now since it requires the preparation of relevant materials as well as appropriate teacher education and professional development programs. A thorough study needs to be conducted on the possible integration programs which reflect common African traditions and contemporary thought. These materials can then be developed and tried in in selected schools as discussed earlier. Many lessons have been learned from the trials of integrated materials in other

African countries, such as in Nigeria (Jegede, 1980; Onocha, 1990) Zimbabwe and Botswana (Knamiller, 1982) and should be taken seriously in developing any new integrated science programs in Africa. Such lessons include: Programs must not demand expensive equipment, language issues must be addressed; and professional development programs must be built in each new innovation. Osaki (1987) proposes that integrated and subject specific environmental approaches could be compared to determine what each one has to offer in terms of environmental literacy, environmental attitudes, analytical thinking and process skills development. A stress on science skills and cognitive processes is essential. Employers would have to be educated to recognize the potential of students who take the integrated options at the secondary school level. Studies elsewhere show that such an approach is as academically rigorous as the subject specific approach, (Skinner & Fairbrother, 1988) if teaching emphasizes science skills and cognitive processes and focuses on seeing things more holistically. Of course, caution must be taken in the development of appropriate teaching and learning materials and student evaluation systems. As found in this study, examination success continues to be an important part of schooling. It might be used to encourage the development of environmental knowledge, skills and attitudes by focusing on examination questions relevant to those issues. In a recent study in Nigeria, Onocha et al. (1990) found that long serving teachers involved in teaching the Nigerian Integrated Science Project (NISP) had returned to expository teaching and spent less time promoting learning, and more time on monologue. Student teachers prepared to use NISP materials did exactly the opposite. This finding is supported by the findings of this study. However, Onocha's findings seem to suggest that these same student teachers will likely reconstruct their teaching style when they go into full time teaching where peer pressure and student expectations may work against the role of the teacher as a facilitator of learning rather than an information giver. This *reconstruction* of the new learning which teachers (and probably other professionals) receive during pre and in-service courses perpetuates the status quo. It is unfortunate that the more experienced teachers who maintain the status quo can be the poison of the profession through their arrogance and dismissal of new thinking, especially when it comes from a "novice" or "academic."

The role of global NGOs.

The interview with the Chief of Environmental education at UNEP indicated that UNEP and UNESCO had done what they could by distributing the materials they had produced to member countries, including Tanzania, through their ministers of education. A list of current UNESCO-UNEP materials (Table 15) suggests that some are very relevant to teachers, teacher educators and curriculum developers. However, as the chief indicated, U.N. bodies cannot interfere in government plans or force them to use these materials. This seems to imply that if there is no political will on the part of the government, nothing changes. Interviews with the ministry coordinator of EE indicated that UNESCO-UNEP money was used to fund 3 seminars as described earlier, though these seminars were attended more by ministry administrators than school teachers. The ministry coordinator further indicated that he was applying for more funds to conduct a nation wide study on the status of EE, while knowing very well that very few teachers had taken part in these workshops and no resource materials were available for classroom use. These findings reveal a number of contradictions, but do not rule out the role of UNEP, UNESCO and other NGOs. which have assisted in many aspects to strengthen various curriculum reforms in Tanzania. However, I saw the need for a coordinating committee with representatives from various interest groups including the Ministry of Education, Institute of Curriculum Development, the Colleges of Science Teacher Education (including University faculties of education) and the Science Teachers Association. Such a committee could coordinate the support system for teachers involved in the preparation of new materials; work out priority areas in need of urgent funding; and, develop a data base for NGOs willing to assist in funding. The advantage would be to reduce the duplication of efforts and ensure that a more systematic approach to curriculum development is followed. Thus, if some NGOs agree to fund workshops for the adaptation or development and trial of new teaching materials, others might assist in funding and providing in-service programs producing appropriate teaching materials.

As in the past, there may continue to be problems in that some NGOs. seem to be only interested in working with certain groups such as universities or ministries, and only funding the production of materials for specific groups (e.g women). The coordinating committee would have to ensure that NGOs know where their help is most needed and that they agree to support the long term goals of addressing local and regional environmental issues through their inclusion in the science curricula.

Many NGOs operating in Africa include staff members who are experienced educators. Some of them worked in Africa or other third world countries during the 1960s and 1970s and returned to their home countries when the funding for educational reform in post independent Africa was exhausted (See Yoloye, 1985; King, 1990). Some have many ideas about the needs of EE for African students, but cannot claim to have the solutions to the present crisis in science education. These people could collaborate with local scientists and the curriculum coordinating team to compile locally focused teaching materials from available scientific research and traditional thought. In biology, there are numerous studies on the biology and ecology of African wildlife and aquatic fauna and flora being used in western museums to illustrate various biological phenomena but unknown to most teachers in the schools. [2] Unique studies on the genetic and biochemical properties of African flora and fauna are abundant in scientific journals but not yet part of most African school science curricula, Tanzania included. These would be an important contribution to the new texts of biology and ecology for African students. The most valuable role for NGOs. would be to secure expertise who might further assemble such African studies and fund their work.

It needs to be emphasized that a new type of " NGO expert" is envisaged here. Such experts must be people who are capable of reflecting on the possibility of indigenizing the science curriculum, while at the same time emphasizing the promotion of science skills and cognitive processes over the mere acquisition of content. The emergent ideas would then be subjects of in-service workshops for teachers in small communities. As Kenneth King suggests, the main challenge is for the search of foreign experts , where necessary, who are ready to assist local scholars and educators to exploit the sources of local creativity, and "for them (foreign experts) to act as honest brokers between local cultures of schooling and the impact of foreign monies from the global sources" (King, 1990, p.55). To do this successfully, foreign experts must conceive themselves as collaborators in the process of solving a global problem in a local context, rather than in a trainer/trainee or donor/donee position. Most people now agree that any efforts designed to increase scientific literacy and environmental literacy at the global level are important in order to save the earth and should be supported by those who have the means to do so.

At present, western donors in the education sector appear to have begun to work together with local educators. In 1989, for example, a report completed by experts from the Tanzanian Ministry of Education, UNESCO, the World Bank and other NGOs (e.g DANIDA, SIDA, ODA, NORAD and so forth) highlighted past achievements and the areas needing future donor support in Tanzania. The report identifies science education as an important area, with special emphasis on "the training of trainers, qualitative improvements in both primary and secondary schools, qualitative improvements in teacher education, and expansion at the university level." [3] It neither addresses the need for curriculum reorientation and localization, nor does it rule it out. If the local experts have no sense of the role of local issues, language problems and teacher motivation as revealed in this study, then whatever monies invested in education will likely continue to perpetuate the existing weaknesses in science education.

In the interview with the UNEP representative, it seemed that their awareness of local problems was rather low and hence, while they might think they have done a lot to promote EE by supplying ministers and other high ranking officials with materials, they seemed to have had little influence in the process of negotiating these ideas down to the classroom level. They had no connections with any one at the grassroot level and so were unable to evaluate the impact of their materials in school settings. In Kenya, the presence of various foreign NGOs. based in the city of Nairobi seems to have had an impact on creating environmental clubs in the schools. It is not clear as to whether they have succeeded in getting environmental issues integrated into biology education or across all science curricula. Relevant questions might be addressed in future studies. Although I have studied only three schools, there is evidence from this research and the work of others that U.N. bodies and other NGO efforts will need better local coordination and support to reach their grassroot targets, including teachers and students. Above all, it is once again demonstrated that the mere prescriptions of curriculum cannot stand the complex process of negotiation at the classroom level if those involved at the grassroots are not fully mobilized to participate in the creation of those prescriptions.

RECOMMENDATIONS

From the implications of this study, the following recommendations are made.. First, the process of setting or redefining curriculum goals, including the emphasis on environmental or technological issues, should be encouraged to develop from the grassroots. Teachers in each zone should be encouraged to meet and discuss in workshop settings what any new innovations will involve at the classroom level, and share the job of developing teaching and learning materials. This will strengthen professional teacher organizations such as STAURT and CHAKIWATA. Teachers must also play an active role in the decisions of examination formats. This might reduce teacher alienation and the lack of interest in curriculum change. This extra work must be accompanied by better conditions of work and pay for the teachers, including the right to fight for these better conditions through free trade unions.

Second, the expertise of local professionals such as the Zonal School Inspectors and College of Education tutors and scientists in each locale needs to be used in leading teacher seminars and workshops focusing on the use of the local environment in science teaching. Headmasters and department heads should encourage their teachers to invite local fisheries, forest and wildlife, medical and other scientists to talk to students on the work going on in their sectors during relevant school sessions.

Third, research on positive and negative aspects of traditional cosmology needs to be initiated and a teaching/learning unit developed, which could broaden the knowledge of student teachers of science subjects on the difference between traditional African and modern scientific cosmology. As a study by Ogunniyi (1986) showed, such exposure to teachers may improve their understanding on the processes of scientific inquiry and they may be better equipped to handle classroom discussions. Both the Diploma and degree programs in science education need such units of study.

Fourth, the MOE needs to make a formal commitment to environmental education by issuing a formal Ministerial Circular and providing funding for supporting teachers' efforts in each zone. Materials provided by NGOs should be placed in a central office in each zone (probably a teachers' center) for use by the teachers.

Fifth and finally, a National Curriculum Coordination Committee needs to be established with representatives from the MOE, the Institute of Curriculum Development, the Universities and teacher education institutions, as well as other professional organizations (such as the National Science and Technology Commission) teachers unions and the Party organs. This Committee will coordinate all the efforts to improve the curriculum from preschool education to tertiary education and the non formal sector. The committee should ensure that issues such as environmental and technological education are established across curricula at all levels. It will consult with teachers organizations such as STAURT and CHAKIWATA on the feasibility of using integrated science teaching approaches, or whether environmental issues should be better infused in the separate science disciplines at all levels, and seek ministerial support for professional development programs necessary for such a commitment. It would also collaborate with the mass media in developing distant education programs such as radio and Television programs and posters, which are important in raising mass consciousness in environmental and technological issues.

SUGGESTIONS FOR FUTURE RESEARCH:

This study was confined to government schools located in 3 environmentally unique zones of a large city in Tanzania. The findings describe the situation with regard to EE in the selected city schools, and reflects some specific problems characteristic of a large city in a developing country.

1. Similar studies should be done in rural areas in both government and private schools so that a more complete picture of environmental education in Tanzania can be described. Also of interest would be to include, in such studies, teachers who attended the UNESCO-UNEP workshops held since 1987, and long serving teachers whose professional expertise might be of interest for future teacher education. Together, the findings of such studies would enlighten curriculum developers who want to develop environmentally relevant teaching materials for all school systems. They would also enlighten teacher educators and organizers of professional development programs for EE in science teaching in general and biology teaching in particular. They might also contribute to the theoretical significance of the social constructionist approach by uncovering the life history patterns of teachers who have attempted to use an environmental approach, and if possible the

impact of their approach to student performance and interest in the environment.

2. The students' learning of science should be further investigated through interviews. Such interviews might address such questions as Which topics are best studied in school as opposed to those studied out of school? What influence, if any, does non formal science learning (including traditional cosmologies) have on classroom learning? What impact does relevant environmental learning have on student motivation, performance and attitudes towards their environment?. And finally, what role does language play on student understanding of local environmental issues? These studies might help increase the understanding of students' construction of phenomena in their environment and provide the basis for the development of new teaching resources. They might also pave the way for a serious discussion on the role of Kiswahili in science teaching in Tanzania.

3. Studies on the role of external examinations in motivating teaching and learning of environmental issues also need to be conducted. If such examinations have to continue, appropriate studies should provide ideas on the role these examinations might play in promoting a serious study of local environments in relation to gaining a better understanding of the global scene.

4. Finally, studies should also be conducted on the development and trial of environmentally oriented biology (and other subjects) textbooks. Such studies should concentrate on the possibility of collaborative ventures involving school teachers and should be decentralized so that every region develops studies that address its own local environmental issues. The findings of such studies can then be used by a Curriculum Coordination Committee in making relevant curriculum decisions at various levels in the country.

NOTES

1. English will continue to be taught in school and used in university (See North, 1985) but to use it as a medium of instruction in secondary schools will be very painful for learners.

2. Displays of the evolution and diversity of Cichlid species of Lake Victoria, behavior and ecological role of African fauna in our ecosystem, desert encroachment in the Sahel etcetera are among the major exhibits of the British Museum (Natural History) in London and such other western institutions.

3. Quoted from the Summary of proposed areas for donor support, UNESCO, (1989). United Republic of Tanzania- Volume 1 Overview, Paris, 1989. and IMTEC (The International Learning Cooperative). The Education Sector: A Summary of Issues. Per Darlin, IMTEC, Oslo, March, 1989).

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Appendix "A"

QUESTIONNAIRE TO BIOLOGY TEACHERS

1. This questionnaire is intended to collect basic information about the experiences of teachers involved in the teaching of the Tanzanian Secondary School Biology Syllabus. The information will be used in a research project intended to study the problems facing biology teachers in their attempts to use the biophysical environment in their teaching. Eventually, it might be used to improve our training of teachers, as well as developing in-service programs for teachers in the field.
2. Please respond as accurately as you can so that we work with accurate information.
3. None of the information you give shall be used for any purpose other that what we have stated above. Should that be the case, your permission will be sought first.

Basic information about the teacher.

Teachers' name
(optional)..
School...
Location of the school...

1. Academic/professional education (Please list post secondary institutions only)

(Institution) (Years attended) (Major subjects studied)
(Degrees)

....
....
....
....

2. Teaching experience.

(School) (Years) (Subjects taught) (Forms) (# periods)

....
....
....
....
....

3. Extra professional/administrative duties in schools

(School) (Responsibilities) (Years) (Other Remarks)

....
....
....
....
....
....
....

4. (a) What syllabus did you use when you first started teaching?

....

Has it changed ever since? Yes/No
If yes, please respond to 4 b) -d); if no, please go to 5.

4 (b) Who initiated the changing?
....

4 (c) How was it communicated to you?..

4 (d) What new teaching materials were recommended?
....
....

5. Please list the books you have used for teaching form 3 biology.

(Title and author) Used by (teacher/students,) (Reasons for using it)
....
....
....
....
....
....
....
....

6. Please list down any workshops, meetings, or seminars, you have attended in connection with the teaching of biology.

(Title of workshop, etc.). Organized by (Issues addressed)
....
....
....
....
....
....
....
....
....

7. Please complete the table below stating how often you use the teaching resources listed over a school year. In column 2, use **1** for often, **2** for rarely, and **3** for never.

(Teaching resource) (How often) (For what sort of activities)

Biology laboratory
....
....
....
....
....

The outdoor environment
....
....
....
....
....

The classroom

....

....

....

....

....

....

Others (Please specify)

....

....

....

....

Brief interview at the end of classroom observations.

1. What resources* did you consult when planning this lesson? (* books, AV materials, outdoor observations, laboratory activity resources et cetera.)

2. Did you consider what roles the students' home and school environment could play in this lesson?

Interview at the end of the 12 of observation sessions.

1. You will have filled in the Biology Learning Activity Checklist (BLAC) by now. Are the activities in the checklist feasible?

2. What sort of activities do your students find
(a) interesting? Why?
(b) not interesting? Why?

3 What kind of activities are most difficult: a) for students (b) for yourself.

4. (a) The biology syllabus you are using suggests that biology is about "knowing ourselves and our environment" (p.53). What does this mean to you?
(b) What would you consider to be an "environmental approach" in biology teaching in this school? For what concepts might it be applicable?
(c) What kind of books could be used for such an approach?
(d) What activities would students do?
(e) In your opinion, is an environmental approach feasible? Why or why not?

For teachers who have taught in several schools

5. (a) Did you teach this topic (the one we observed) any differently in the other schools? If yes, in what ways was your teaching of the topic different in the other schools?

(b) Did staying longer in one school influence your teaching style? How?

6. Briefly describe what you consider to be the best way to teach biology in a secondary school.

Why do you think so?

Appendix "B"

SCIENCE TEACHING OBSERVATION GUIDELINE

To the observer.
This is a guide for the observation of classroom processes (teacher talk, or other activities, student talk or other activities) taking place during the biology lesson.

Purpose

To record classroom conversations and activities during the entire lesson as follows.

Topic..

Time starting..

Notes on classroom proceedings.

(Time (min.) (Teacher activity.) (Student Activities) Notes)

....
....
....
....
....
....
....
....
....
....
....
....

(Separate sheet used to record as much of the classroom activities as possible)

Stopping time...

Post observation interview follows.
What planning was involved ?
....

In what form did the environment (of the school, home, contribute to the classroom discussion?
....

In what form did other resources contribute..
....

(Record further conversations on a separate sheet of paper)

Post observation analysis.

Enter observations to the following table.

Date..

Topic of the lesson...

Teacher's name...

Observer's name..

Setting. (classroom/ Lab./ Outdoor)...

[Category of activity] [Teacher/student] [Frequency] [Source]

E.g. Questions asked/answered

....

....

....

Statements made

....

....

....

....

....

Directions given

....

....

....

....

....

Activities
performed..

....

....

....

Appendix "C"

BIOLOGY LEARNING ACTIVITY CHECKLIST (BLAC)

Instructions to the student

This questionnaire is intended to explore your involvement in the learning of biology. It is important for us to know what you have been doing and whether you have enjoyed it, so that we can use your ideas in developing better reading materials for students like you. Thank you for your cooperation.

School...
Form.. Former
school..............................District of former school...

Fathers' occupation...

Mothers' occupation.. ....

Where, in Tanzania, were you born?...
Which region of Tanzania do your parents come from?...

1. Below is a list of activities concerned with the learning of biology. Please indicate, by placing a **V** on the appropriate column, with whom you have performed these activities: (a) present biology teacher (b) previous teacher,(and class) (c) other person.(e.g. parents, peers, members of a shared hobby, etc.)

2. If you have been involved in the activity with any of the categories of people on the columns, put a (V) below the appropriate column. If not, please leave it blank.

3. In order to be accurate, please take time to think about the activity described before you make a response. If you do not understand the sentence, please do not hesitate to ask what it means.

ACTIVITY ThiTOtherOtherP

1. Identifying living things around the school compound.
2. Drawing/labelling living things in their natural habitat.
3. Drawing/labelling preserved specimen in the lab. or class.
4. Generating local names of plants/animals around the school.
5. Visiting the museum to study biological specimen.
6. Observing the behavior of a specific living thing .
7. Collecting water from a pond/lake/river and observe.
8. Observing breeding grounds of a harmful/useful local insect,((e.g, a housefly, mosquito, tsetsefly, bee, etc.)
9. Bringing some living things to the lab for further study.
10. Explaining behavior of a plant/animal you know well from home,or school .
11. Visiting a school garden or shamba for a biology lesson.
12. Looking at drawings of organisms which are found in Tanzania.
13. Reading a book or paper in order to search information on East African /Tanzanian soils, flora or fauna.
14. Talking or writing about things you do at your home which are of biological interest.
15. Comparing eating habits of your home area and those of your fellow classmates'
16. Finding out traditional methods of doing things e.g preserving food, brewing alcohol,

treating diseases, in a local area.
17. Tracing a local food chain around the school or your home area.
18. Observing/discussing any ecological problem around the school/village e.g, shortage of firewood, making of charcoal, soil erosion, etc.
19. Observing/discussing how the school handles refuse /garbage.
20. Discussing how animal or human sewage is dealt with in a village or towns.
21. Giving a local explanation of any biological phenomena.
22. Finding ways of saving a decaying environment (e.g, forest, lake, sea).
23. Discussing any controversial environmental issue facing your school or country in groups and develop ways to make an informed assessment of the consequences of a proposed decision.
24. Discussing the interrelationships of the animals in any Tanzanian Game park.
25. Making or discussing a list of the animals in danger of extinction.
26. Discussing local causes of pollution in Tanzania or Africa in general.
27 Discussing relevance of recent discoveries in East Africa e.g, the use of *Crotalaria ochreleuca* (marejea) or *Azolla* in improving soil fertility, or the use of the improved charcoal stove and other devices to save charcoal when cooking.
28. Visiting the local hospital/health centre to study something.
29. Examining the adequacy of data, and validity of conclusions from a book, newspaper, or local story discussing a biological problem.
30. Working with a biological model, e.g, of the heart, skeleton, etc.
31. Studying a film/slides discussing/showing any biological phenomena.
32. Dissecting or observing the inside of a dissected animal.
33. Observing microorganisms e.g, yeast, fungi, bacteria under the microscope.
34. Doing simple chemical tests on local foods like cassava /maize.
35. Devising methods of solving an ecological problem.
36. Discussing how pollution has endangered life forms in some parts of the world.
37. Doing a project on the biology of an important organism found in Tanzania.
38. Studying any current biological problem around your school or home and a write a report.
39. Listening to a local expert (from the university, research institute, hospital etc.) speak about biological issues.
40. Comparing traditional methods of preventing soil erosion with modern ones
41. Comparing some traditional ways of explaining biological observations and arriving at conclusions to the scientific way of explaining those observations.
42. Looking for authority /assumptions underlying a certain biological phenomena.
43. Participating in solving a problem facing your community environment, e.g cleaning part of the city, planting trees, putting terraces on farms.
44. Using your knowledge of other subjects (e.g, chemistry, geography, physics etc in addressing a biological problem.
45. Reading about organisms living in other parts of the world.

APPENDIX "D"

LETTERS OF PERMISSION TO CONDUCT THE RESEARCH

UNIVERSITY OF DAR ES SALAAM

FACULTY OF EDUCATION

Telephone No: 49192-9

Our Ref: EPA/M.1

Your Ref:

P.O. Box 35048, Dar es Salaam
Tanzania

Telegrams: UNIVERSITY
DAR ES SALAAM

November 29, 1990.

Mr. Funja O. Saki,
Department of Secondary Education,
341 Education South,
Edmonton, T6G 2G5,
Alberta, CANADA

RE: REQUEST TO REPRODUCE THESIS MATERIAL.

Permission is granted to Mr. F. Osaki to reproduce Tables 6.3 and 6.4 from my PH.D thesis (1989).

J. C. Galabawa, PH.D
HEAD, EDUCATIONAL PLANNING AND ADMINISTRATION

JCG/mem:

UNIVERSITY OF DAR ES SALAAM

Ref: No. 19 AB3/3(B)

Date: 19th January, 1990

Ndugu, Director

Malihai Conservation Clubs

ARUSHA

UNIVERSITY STAFF AND STUDENTS RESEARCH CLEARANCE

The purpose of this letter is to introduce to you Mr./ Kalafunja M. Osaki who is a/ bonafide academic member of staff/ of the University of Dar es Salaam and who is/ at the moment in research. Our staff members and students undertake research activities every year during the vacations. In accordance with the Resolution of the then TANU at its meeting held on the 11th March, 1972 (Min.9/71/VI), University staff and students were granted general permission to carry out research. The University Administration was empowered by that resolution to give clearance at its discretion to its staff and students.

We request therefore to grant the above mentioned member(s) of our University community any help that may facilitate his/ research objectives. What is required is your permission for his/ to see and talk to the leaders and members of your institution in connection with his/ research.

The title of the research in question is Factors influencing Teachers' use ironmental resources: A case study of Biology Teaching in Tanzania.

The period for which this permission has been granted is from January to 190 and will cover the following areas/offices

Malihai Conservation Clubs

Should some of these areas be restricted, you are requested to kindly advise him/her/them as to which alternative areas could be visited.

In case you may require further details/information, please contact:

Research and Publications Office

Telephone No. 49192 Ext. 2021.

Yours sincerely,

THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION

Telegrams: "ELIMU". DAR ES SALAAM
Telephone: 27211-9
Telex 41742 ELIMU TZ
Proj. Co-ord. 29906
Chief Build Adm. 20122
Qty. Surv. 2022
In reply please quote:

SECTORAL PLANNING DEPARTMENT,
PROJECTS IMPLEMENTATION SECTION,
P.O. Box 9121,
DAR ES SALAAM

Ref. No. ED/EP/GC/VOL.II/385

14th February, 1990.

THE HEADMASTERS/HEADMISTRESSES,
TANZANIA MAINLAND SECONDARY SCHOOL.

RE: A PROPOSED RESEARCH BY K.M. O-SAKI

The bearer is a student pursuing a PhD course at the university of Alberta Canada, and is currently indulged in reasearch work. His area of interest falls within secondary education and as such he would like to discuss with teachers and probably with some students on various academic issues.

This is to request the schools' administration to give maximum co-operation to the bearer so that he achieves his goal. Hoping that this matter will be given due attention.

I.T. Hatib

I.T. Hatibu
for: PERMANENT SECRETARY.

APPENDIX "E"

INTERVIEW GUIDE FOR THE NATIONAL BIOLOGY CURRICULUM COORDINATOR

1. Are there any recent changes or developments in the biology syllabus.

2. Have you heard of the global focus on Environmental education run by UNESCO? When did you hear about it, and what was your response to it?

3. What does the term "environmental education" mean to you?

4. Has UNESCO/UNEP provided you with any (a) Teaching materials.

(b) Expertise or financial Support for EE workshops/seminars for teachers? Can you describe what transpired in one of the seminars.

(c) Do you think it had an impact on classroom teachers?

(d) What other activities are being carried out by UNESCO-UNEP support with respect to environmental education?

5. What other organizations support you with information materials on EE ?
What are some of the materials they have supplied you with?
Which of these have reached the schools?

6. Have you produced any teachers'/ pupils' reading materials emphasizing an environmental approach?

7. Would you say that the present curriculum guide (Biology syllabus) encourages the environmental approach? How?

8. In what way are the conditions in the schools conducive for this kind of approach?

9. What kind of collaboration do you have with African governments with regards to environmental education issues?

10. What do you consider to be the best way to incorporate environmental issues in the biology syllabus in the present circumstances?

Thank you very much for your time and discussions.

APPENDIX "F"

INTERVIEW GUIDE FOR THE UNESCO / UNEP CHIEF OF EE

1. What exactly do you mean by "environmental education" (EE)"?

2. In supporting EE programs, what is your philosophy-
(a) What would you consider to be the most important components of a sound EE program?

(b). Do you consider any specific balance between local/global issues necessary?

3. When did UNESCO begin promoting environmental education in Africa?

4. Who do you liaise with to reach the schools in the countries you deal with?

5 a) What are the broad objectives for EE in African countries?

b). Do you have separate policies for each country ?

6. Can you name any specific school biology programs of EE you have helped establish in Africa?

Who were involved?

Whose idea was it?.

What role did you play?

What kind of support did the government provide?

Which schools/institutions benefitted from the project?

What impact, if any, has the project had on the community it was intended for?

7. What present projects involve secondary school biology teachers in Tanzania?

8. How has your budget been changing during the last 5 years ?

APPENDIX "G"

OBJECTIVES OF THE BIOLOGY SYLLABUS (CURRICULUM GUIDE) "O" LEVEL, 1976.

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF NATIONAL EDUCATION

SECONDARY SCHOOL SYLLABUSES

Sciences

- Physics
- Chemistry
- Biology
- Mathematics

ISSUED BY
THE MINISTRY OF NATIONAL EDUCATION
DAR ES SALAAM, TANZANIA.
1976

BIOLOGY

FORM I—IV

Introduction:

Knowledge of Biology, it must be emphasized, is a cultural requirement, for we all need to know ourselves and our environment. Since all man's needs find their satisfaction in nature, it is through a better knowledge thereof, that he will be able to raise his standard of living. Application of Biological principles concepts and knowledge should be the spur in Biology courses, since knowledge for which no use can be perceived is soon forgotten, and cannot to a worthwhile education.

Teaching of Biology tries to look particularly into its role in agriculture: animal husbandry, crop husbandry, forestry, fisheries, nature conservation, para-agricultural industries, human nutrition, heredity, ecology, and the interaction of man and his environment: so that man could utilize his natural heritage (land, plants and animals) to his best advantage without destroying them.

The main objective in teaching biology, therefore, is to enable the graduates in biology to apply the biological principles, concepts, knowledge and skills so acquired, to their rural community, so that they could best utilize their natural heritage (land, plants and animals) without destroying them, to raise their standard of life and free themselves from diseases, poverty and ignorance.

TOPICS:	NOTES:
1. **INTRODUCTION TO BIOLOGY:** — Meaning — Objectives — Methods.	
2. **INTRODUCTION TO PRINCIPLES OF CLASSIFICATION:** Diversity of living things and their distribution.	Characteristics of living things, living and no living things compared. Plants and animals compared.
	Sorting of living things based on similarities and differences, habitats, sizes and shapes by inquiry approach.
Major groups of Animals and Plants.	Observation of External features, habitat and movement.
One celled organisms Protozoa: *Trypanosome / Plasmodium / Amoeba Paramecium.*	
Worms: Ascaris, earthworm and Tapeworm.	Use of pertinent features to group animals into vertebrates and invertebrates; plants into flowering and non flowering.
Arthropods: grasshopper, mosquito, crabs; fish; amphibia; reptilia; birds; and mammals.	Emphasize general features without going into details of anatomical and physiological aspects. Practical observation of different types of feathers.
3. **CELLS STRUCTURE AND FUNCTION:** Structure and function of Plant and animal cells.	Structure of typical Plant and animal cells. Cell structure to include only cell wall; Plasma membrance, cytoplasm, nucleus and cell vacuole. Comparison between Plant and animal cells.
Plant and Animal tissues, organs and systems: e.g. Vacular, Ground, Mechanical & Connective.	Stress how structure (shapes of various tissues, organs and system) relates to function.
Interaction of materials within and around cells.	Diffusion & Osmosis, turgidity, plasmolysis, wilting. Permeability in the living cell. (Practical experiments to illustrate the above phenomena using living and non living materials) — stress the differences.
4. **PARASITES AND DISEASES OF MAN:** Meaning and survival problems of parasites. Infections of Biological origin. Principles concerning the relationship between man and the pathogenic agents.	
The world of microbes: Experimental introduction to techniques and methods of microbiology.	Microscopic observation of bacteria. Culturing of bacteria.

TOPICS:	NOTES:
Diversity and characteristics of pathogenic agents.	Refer to Bacteria, viruses and worms and insects as vectors, life cycle of mosquitoes.
Major endemic diseases in Tanzania.	Refer to Bilhazia, typhoid, Malaria, leprosy, T.B., dysentery and Venerial diseases.
Principal infectious diseases and their classification according to the methods of transmission.	Infection transmitted by air, water, food, contagion from the ground, contact & vectors. Control of such diseases.
5. **SOIL AND PLANT GROWTH:**	
Soil formation — agents of soil formation Chief constituents and properties of soils. viz. living components and non living components.	Soil forming agents to include:- Running water, wind, temp, dilute acids, animals and plant roots. How soil properties are related to soil forming agents. Measurements of the following mineral contents of soil N.P.K. and lime using soil test kit.
Soil Profie	To illustrate natural layering of soils, during field work.
Soil analysis by Mechanical process (partical size)	Use of sieve and sedimentation.
Soil water; Measurement of soil water Content:- Water retentivity, capillarity, porosity, and field capacity.	Origin of water:- rainfall, irrigation, atmospheric humidity: Compare soil water contents in sandy, loam and clay soils. (practicals necessary)
Soil fertility and plant growth. Loss of soil fertility and control measures. Manures and fertilizers: types and their uses.	Factors leading to loss of soil fertility to include — leaching, plants, erosion, wind, poor farming practices, burning. Control measures to include; control of soil erosion, reafforestation, application of fertilizer, guard against excessive over grazing & good farming practices. Demonstration plots are very essential.
6. **NUTRITION:**	
(a) Plant Nutrition. Leaf structure; gaseous exchange.	Microscopic observation of T.S. of a named leaf to identify the different Parts/layers: Distribution of stomata, chloroplasts and air spaces. A variety of leaves could be observed.
Water and mineral absorption in plants.	Water uptake by roots; water culture experiments:- emphasize N.P.K.
Photosynthesis and conditions affecting it.	Raw materials and their sources. Simple treatment of the role of each constituent parts. Simple treatment of the mechanism of photosynthesis. And products of photosynthesis and their uses.
Synthesis of fats and proteins from carbohydrates.	
Food storage and storage organs.	

TOPICS:	NOTES:
Special modes of nutrition in plants.	Saprophytism in mucor/rhizopus; parasitic plants:- striga/orabanche on tobacco/mistletoe. Adaptations of these modes of nutrition as a result of lack of chlorophyll or roots.
(b) Animal Nutrition. Food sources and habits for human and other animals.	Omnivorous, carnivorous and herbivorous distinguished.
Basic food materials — viz. Carbohydrates, fats, proteins; their simple identification.	Include the sources of these food types. Reducing and non-reducing sugars.
The role of constituents of food including water, mineral salts and vitamins.	Functions of each to the body including deficiency symptoms.
Balanced diet for animals.	Meaning; survey of food values and nutritional levels. Energy requirements for human beings. Food diets for expectant mothers (pregnant women) and babies during suckiing and after weaning.
Malnutrition in Tanzania.	Meaning of malnutrition, deficiency disorders and their symptoms. Spread and causes of malnutrition in Tanzania.
Feeding and digestion in mammals.	
Adaptation of mouth parts in relation to types and methods of food uptake.	Tooth structure, (canines, molars, incisors); beaks. Dental formulae, teeth care and tooth decay.
The alimentary canals of man and cow in relation to food types.	Ruminants and monogastric compared.
Digestion process in man.	Functions of digestive enzymes of the mouth, stomach, duodenum, ileum. Functions of the liver.
Absorption and assimilation.	
Food preservation and storage.	Food contamination, the need and Methods of preservation.
ENZYMES and their characteristics.	Simple experiments to demonstrate the effects of temperature, pH, enzyme concentration on enzyme activity.
7. **TRANSPORT IN PLANTS AND ANIMALS:**	
Structure of stems and roots.	Refer to monocots and dicots.
Transpiration and conditions affecting its rate.	Experimental demonstration of conditions affecting transpiration, transpiration pull, root pressure.
Transportation of water in plants.	Use of coloured water to show the path of water from the roots to the leaves.
Composition and function of mammalian blood. Blood clotting.	Observation of mammalian blood under the microscope. Anaemia Leukemia, Haemophilia.

	TOPICS:	NOTES:
	Structure of heart and blood vessels. Blood circulation.	Observation of major blood vessels and lymph vessels. Causes of blood pressure.
8.	**BREATHING AND RESPIRATION:**	
	Organs of gaseous exchange. Breathing mechanism in man, insect and fish.	Reference to be made to the lung, trachea, gills and skin. Hazards of smoking.
	Respiration — Breaking down of food to release energy. Glycolysis and role of ATP	Need for energy — ATP as a store of energy, formation of ATP., Breakdown of ATP to ADP., muscle contraction and ATP break down. Accumulation of lactic acid.
	Aerobic and Anaerobic respiration.	Formation of alcohol. *Yeast* in relation to bread & alcohol formation.
9.	**REGULATION IN ANIMALS AND PLANTS:**	
	Excretory Organs.	Formation of urea in mammalian liver.
	Formation of excretory products in animals.	
	Elimination of excretory products. Factors affecting amount of excretory products.	Functions of kidney — uriniferous tubules osmoregulation — Skin as excretory organ.
	Temperature regulation in warm and cold-blooded animals.	The need for temperature regulation; hibernation and torpidity in cold blooded animals.
	Excretion in Plants.	

	TOPICS:	NOTES:
10.	**CONTROL AND CO-ORDINATION SYSTEMS IN ORGANISMS:**	
	Response in plants and animals to stimuli-light, water and gravity.	Hormonal explanation of these responses.
	Plant hormones (especially auxin)	Application of plant hormones as wood keelers.
	Nervous System.	Structure of the nerve cells (Neurons) Types of nerve cells i.e. motor, sensory and relay. Nerves: Sensory, motor and mixed.
	Spinal cord.	Spinal cord as seen in T.S. Simple and conditioned reflex.
	Brain.	Gross structure (viz. olfactory lobe, cerebelum, cerebrum medulla oblongata) Functions of these parts. Demonstrations of brain parts to be carried out using models.
	— Sense Organs	Parts of the eye and their functions. Formation of image.
	. eye	Eye defects and their corrections.
	. ear	Detection of sound and balancing mechanism.
	. skin	As a sense organ of touch, pressure and temperature.
	. tongue	Location of taste buds (viz. sweet, sour, bitter and salt).

TOPICS:	NOTES:
nose	As an organ of smell (olfactory).
Endocrine system: Adrenals, pancrease, pituitary, thyroid, ovary and testis. Stomach, duodenum.	Location of position, secretions and functions Emphasize growth hormones, Thyrotropic hormones, Gonadotropic hormones, thyroxin, oestrogen, testosterone, adrenalin, secretin and gastrin
11. **MOVEMENT IN ANIMALS:**	
Simple movement in Amoeba.	
Muscular movement.	How muscle and bones bring about movement.
Skeleton and joints of limbs.	Antagonistic muscular activity. Details of specific bones not required. Mechanism of limb movement.
Movement in insects, fishes, birds and mammals.	Structural adaptations of each to movement in water (fish), air (birds) and land (mammals).
12. **GROWTH:**	
Meaning of growth.	Change in size and form.
Factors affecting growth.	Emphasize Food (nutrition), environment, hormones.
Growth in plants: seed structure and germination: essential conditions for germination.	Part played by each seed part, types of germination (Epigeal hypogeal). Experimental determination of conditions necessary for germination.
Regions of growth in plant roots and stems.	Experiments to show the growing regions of shoot and root.
Mitosis.	Duplication of chromosomes, details of specific stages not expected. Microscopic observations of root tip cells.
Primary and Secondary growth in plants.	Formation of rings, comparison between dicot. and monocot. Stems and roots.
Growth in animals: Metamorphosis in Frog; house fly and cockroach or grasshopper.	In frog metamorphosis exclude embryological details — distinguish complete and incomplete metamorphosis; include life cycles.
13. **REPRODUCTION:**	
Meaning and importance of reproduction.	
Asexual reproduction in Plants.	Asexual reproduction in *Mucor/Rhizopus*, yeast. *Bryphyllum* — vegetative propagation.
Sexual reproduction in flowering plants. Asexual and sexual reproduction compared.	Practical study of named flowers to illustrate characteristic of insect and wind pollinated flowers. Cross and self-pollination.
Seed and fruit formation.	Types of seeds and fruits.
Dispersal of seeds.	Practical observation of types and methods of seed dispersal.

TOPICS:	NOTES:
Sexual reproduction in higher animals.	The following animals to be studied — Fish *(Tilapia)*. Birds (weaver bird of chicken) and a small mammal study to include breeding habits, incubation period and parental care. Experimental observations on reproductive organ to be carried out.
Types of fertilization including mating.	Reproduction in Man should be discussed.
Nutrition of embryo and the young.	
14 **GENETICS:**	
Cell divisions — Mitosis and Meoisis.	Mitosis and Meiosis in relation to DNA replication: DNA molecule simply treated.
Chromosomes and concept of genes.	
Mendels laws of Inheritance	Concept of Dominance and recessive (refer to monohybrid cresses only).
Mutations and gene action.	Meaning of mutation.
Methods of breeding in plant and animals of a harder and better characteristics.	Selective breeding in maize, cattle and poultry to be discussed.
Variation among plants and animals of the same or different species.	Include sources of variation — genetical and environmental simply treated.
Blood groups and transfusion.	Refer to A.B.O. blood types and Rh-factor.
15. **EVOLUTION:**	
Theory of evolution. Overproduction; struggle for existence; individual variation, survival of the fittest.	Adaptation and mutations as agents of evolution.
16. **INTERDEPENDENCE OF ORGANISMS:**	
The concept of ecosystem.	Plants as producers; animals as consumers; different types of consumers.
Food chains and food webs.	
Balance of Nature.	Nitrogen cycle, carbon cycle.
Insects as pests of crops.	Life cycle of maize stalk borer/cotton stainer and weevil/coffee mealybug and their effects to crops.
Parasites of animals.	Refer to ticks, fleas and lice.
Organisms and their succession.	A study of plant succession or animal succession by transect method.
Population and communities: Population growth and control.	

APPENDIX "H"

SUMMARY OF THE RECOMMENDATIONS OF THE REGIONAL TRAINING WORKSHOP FOR EE FOR AFRICA HELD AT DAKAR, SENEGAL, IN 1978.

United Nations Educational, Scientific and Cultural
Organization

REGIONAL TRAINING WORKSHOP
ON ENVIRONMENTAL EDUCATION IN AFRICA

Dakar, Senegal, 11 - 20 December 1978

FINAL REPORT

Final Report
ENVED - 1978

UNESCO

Introduction

1. Background

The Intergovernmental Conference on Environmental Education (14-26 October 1977, Tbilisi, USSR) organized by UNESCO in co-operation with UNEP, made Recommendations for action by Member States, as well as International Organizations, in the promotion and development of environmental education. Among other activities envisaged for the follow-up of these Recommendations, a Regional Workshop for key-personnel for the development of environmental education through formal education processes was convened by UNESCO in its Regional Office for Education in Africa (BREDA).

2. Goals

(a) The workshop was to serve key-personnel (teacher educators, curriculum developers, supervisors, educational planners, and educational administrators) whose participation may result in the development of environmental education at the national level.

(b) The workshop was to develop strategies for :

1. establishing environmental education programmes at the national level;
2. curriculum development and teaching-learning materials preparation for primary and secondary schools and teacher training institutions at the national level;
3. the training of teachers in environmental education for primary and secondary schools and teacher education institutions.

(c) The workshop was to promote the exchange of information with respect to programme formulation, teaching-learning materials preparation, and teacher training in environmental education.

3. Participants

Unesco invited all Member States in Africa to send one participant each to take part in a personal capacity in the workshop. Key-personnel participated in the workshop from BENIN, CAMEROON, CAPE VERDE, CENTRAL AFRICAN REPUBLIC, COMORES, DJIBOUTI, GABON, GUINEA, GUINEA BISSAU, KENYA, MAURITANIA, MAURITIUS, NIGER, SENEGAL, SIERRA LEONE, TCHAD, TOGO, UGANDA, UPPER VOLTA, ZAMBIA, ZAIRE.

The organizations of the United Nations System and other intergovernmental organizations in Africa with which Unesco has conducted mutual representation agreements were invited to send observers. Observers from UNEP and ENDA participated in the workshop.

4. Opening Session

The opening session was honoured by the presence of His Excellency Mr. Abd'el Kader Fall, Minister of National Education of Senegal, and representatives from several national institutions and international bodies active in Senegal.

Mr. Bakary Kamian, Director, Unesco Regional Office for Education in Africa, welcomed the Senegalese authorities and participants on behalf of the Director General of Unesco. Summing up the goals of the workshop and the results expected from it, he said that "in order to prepare the citizens of today and tomorrow to give to environmental problems all the necessary attention so that man does no longer continue to unconsciously destroy, with the formidable power brought to him through science and technique, his own climate and life space, and no longer place himself in an irreversible self-destroying position, Unesco has undertaken to help its Member States in preparing and implementing school and out-of-school educational programmes. This Regional Seminar on Environmental Education is attended by specialists from African Member States South of the Sahara who, for ten days, will try to find the most appropriate ways and means to lay the foundations of an environmental education in primary and secondary schools and teacher training colleges in Africa"

"In convening this Regional Workshop, Unesco, trusting your individual motivations and professional qualifications, expects that you will pool your knowledge and experiences acquired during the last decades on environmental education and so help in designing and implementing appropriate programmes and strategies for environmental education in Africa".

"Your task will be facilitated with the tremendous amount of documentation and experience accumulated by Unesco in the field of environmental education".

"It is mostly since the United Nations Conference on Human Environment, held in Stockholm in 1972, that a decisive step was taken in the establishment of an International Environmental Education Programme. After alerting the world conscience to the threats to humanity brought about by the deterioration of the environment by industrialized countries, this conference recommended that 'an interdisciplinary school and out-of-school education programme on the environment, covering all grades of teaching and addressed to all young people and adults be established in order to explain to them the simple action they could undertake within their own limits to manage and protect their environment ' ".

"But you must have felt still more committed to environmental education when, from 14-26 October 1977, an Intergovernmental Conference on Environmental Education was organized in Tbilisi in the USSR by Unesco in co-operation with UNEP. Indeed, those ideas expressed and recommendations adopted at this conference do represent the basic international programme on which all plans of action for the development of environmental education at national, regional and international levels are established. And thus, regional workshops were planned in order to develop environmental education within school and out-of-school education systems".

"Thus, this workshop today is a follow-up to the recommendations of the Tbilisi Intergovernmental Conference. Its objectives are to prepare the most appropriate strategies in order to firstly, integrate environmental education in national education systems; secondly, develo curricula and prepare teaching material for primary and secondary schoo and teacher training colleges, thirdly, to train teachers of environmental education for primary and secondary schools and teacher training colleges".

"Yours will be a very inspiring effort since, as stated by the Director General of Unesco, your effort will aim at orienting 'the development of our education systems so that they are more relevant and more realistic', since they will tend to integrate man within his environment. And, still to quote the Director General of Unesco, 'it is a privileged opportunity to give back to education an ethical function it has sometimes lost' ".

"Ladies and Gentlemen , on behalf of the Director General of Unesco, Mr. Amadou Mahtar M'Bow, I take great pleasure in welcoming you to Dakar and to the Regional Office where you will find during your stay with us a propitious framework for fruitful discussions I am convinced that you will not neglect any aspect of the environment concept which includes not only the lived-in space, the physical, cultural and psychological ambient environment, but which also may be defined in relation to human groups, in relation with the improvement of the environment by the communities which live in it and shape it in accordance with their techniques, their organization systems, their requirements, their constraints and aspirations".

"It might be useful to emphasize the specific feature of the African environment which is that of primarily rural communities, governed by nature or still suffering under the constraints of their environment, and to warn them against the aggressions of industrial economy which attack men through atmospheric pollution and nuisances transmitted through the atmosphere and water pollution which threatens the fragile equilibrium between man and his environment".

His Excellency, Mr. Abd'el Kader Fall, Minister of National Education of Senegal, took the floor and welcomed participants and observers in the name of his government. He was pleased that such an important meeting, important both as concerns its topics and the high qualification of the key-personnel present at it, was convened in Senegal, a country where numerous institutions have started implementing programmes and educational activities related to the environment.

He said that he is convinced that the results of this seminar would serve the African States in the attainment of one of the major objectives of their educational policy, that of using education to promote the integration of the African citizen into his natural environment, giving him a better understanding of this environment with a view to transformin it and guiding its evolution without destroying the natural environmental balance.

He further added that we continue to be confronted daily with echnical assaults on nature, the depletion of our natural resources due to the large-scale use of energy) and the pollution of our national nd cultural heritage. And those factors are reflected in our approach o education, as in the other aspects of our life. There is no way our ducation can remain on the fringe of this struggle. It is becoming rgent that our peoples be instilled with an awareness of the important lace occupied by man in the biosphere. They must be inculcated with n appropriate behaviour, with a view to generating an increasing awareness of their responsibilities. In the process, they must learn to outgrow he stage of contemplation and adopt inquisitive attitudes with regard to nature to attain an understanding of the complexity and interdependence of environmental problems so that they may be equipped to deal with them rationally. The Minister of Education expressed his wishes for a successful workshop, and declared the workshop officially inaugurated.

5. Bureau of the Workshop

At the first plenary session under the chairmanship of Mr. Bakary Kamian, Director of BREDA, the workshop elected the members of its bureau. The following were elected unanimously :

President

Mr. Amadou Dembe DIOP (Senegal)

Vice-Presidents

Dr. Alaric N. BOMA (Cameroon)
Mr. Kangni GBADOE (Togo)

Rapporteurs

Mr. Alphonse BLAGUE (Central African Republic)
Mr. Ephantus M. MUGIRI (Kenya)

6. Secretariat

Mr. Bakary KAMIAN, Director, BREDA
Mr. Mamadou CISSE, BREDA, Dakar
Mr. Abdul GHAFOOR, Unesco, Paris
Mr. Victor KOLYBINE, Unesco, Paris
Mr. Ako Defang MENGOT, BREDA, Dakar

7. Agenda

From then on, the workshop followed the following agenda :

(a) Goals, objectives and principles of environmental education;

(b) Strategies for establishing environmental education programmes;

(c) Strategies for curriculum development and teaching-learning materials preparation for :

- primary schools,
- secondary schools,
- teacher education institutions;

(d) Strategies for training of teachers in environmental education for primary and secondary schools and teacher education institutions through :

- pre-service teacher education,
- in-service teacher education.

8. General Information on the International Environmental Education Programme (Unesco/UNEP) and the Intergovernmental Conference on Environmental Education (14 - 26 October 1977, Tbilisi, USSR)

Mr. Victor Kolybine, Programme Specialist, Unesco, presented the following regarding the above programme :

"Following the international reflections on the interaction between 'man' and 'environment', the United Nations organized a conference in Stockholm in 1977, during which it was recommended that 'The Secretary General, the organizations of the United Nations System, especially Unesco, and the other international agencies concerned, should, after consultation and agreement, take the necessary steps to establish an international programme in environmental education, interdisciplinary in approach, in-school and out-of-school, encompassing all levels of education and directed towards the general public, in particular the ordinary citizen living in rural and urban areas, youth and adults alike, with a view to educating him as to the simple steps he might take, within his means, to manage and control his environment'. Responding to that recommendation, Unesco and the United Nations Environment Programme - the UNEP - decided in 1975 to set up an international programme for environmental education".

"The activities of this programme, including the Inter-governmental Conference of Tbilisi in October 1977, were implemented in the context of the objectives of the Medium-Term Plan adopted by the Unesco General Conference".

'The Tbilisi Intergovernmental Conference represented an important step and a major activity of the first phase of the international programme for environmental education. For the first time in the history of international co-operation, representatives of governments from all the regions of the world met to examine the role that education can play i preventing and solving environmental problems, and to formulate recommendations aimed at guiding future action in that area, at the national as well as regional and international levels. The Conference was the occasion for a highly fruitful exchange of views, because of the in-depth reflection that animated it. The impressive sum of experience and achievements exhibited by the delegates in their numerous reports constitutes an eloquent proof.

The outcomes of this conference can be sorted out in three categories.

In the first place, the Conference revealed the high degree of consciousness which prevails so much on the international as on the national level, regarding the necessity to have formal and non-formal environmental education, at all levels, and according to various means, contribute to the comprehension, prevention, and solution of environmental problems. The Declaration, unanimously approved by the Conference, reflects this trend of thought.

Secondly, the documents submitted at the Conference, and the Conference itself, contributed considerably in boosting the conceptual principles relative to the objectives of environmental education, its characteristics and conditions necessary for its efficiency.

Lastly, the Recommendations approved by all participating government representatives made it possible, while forming a very sound base, to give a concrete orientation to future government action in the field of environmental education, as well as that of international and regional co-operation.

Immediately after the Conference, Unesco focused its attention on the detailed analysis of the Recommendations of the Conference, carefully interpreting this analysis in terms of concrete actions to be incorporated, first to the Programme Activities of the organization for 1976, then, more thoroughly, to the biennial programme submitted to the 20th Unesco General Conference.

This analysis of the Recommendations of the Tbilisi Conference has enabled Unesco to identify five fields of priorities of action concerning international co-operation in environmental education.

The five priority fields are the following :

1) co-operation between the States for the formulation and practice of policies whose aim is to integrate environmental education at different levels of formal and non-formal education;

) training and retraining of teachers, teacher educators and supervisors, researchers, educational administrators and planners, in order to incorporate environmental education within the framework of their activities;

) the promotion and development of programmes of studies and teaching materials in order to incorporate environmental education in school and out-of-school education;

) the promotion of research and experimentation concerning environmental education at the national, regional and international levels;

) the promotion of the exchange of information and experiments concerning environmental education, through a world-wide network, and by a series of publications.

9. Presentation of Country Reports

Participants, prior to coming to the workshop, had prepared country reports presenting an overview of innovative efforts in environmental education development at the national level, in particular with reference to the workshop agenda items and future strategies and plans in this regard. The presentation of these reports enhanced the exchange of information among participants with respect to the development of environmental education in the region and set the stage for concrete work on the agenda items.

10. Introducing the Working Papers of the Workshop

(a) The working paper "Suggestions for Developing a National Strategy for Environmental Education - a Planning and Management Process", prepared by Profs. Stapp and Crowfoot was introduced by Mr. Abdul Ghafoor, Programme Specialist, Unesco.

(b) The working paper "Curriculum Development and Teaching-Learning Materials Preparation in Environmental Education for Primary and Secondary Schools" was introduced by Mr. Ephantus M. Mugiri, Unesco consultant.

(c) The working paper "Training of Teachers in Environmental Education for Primary and Secondary Schools and Teacher Training Institutions - Pre-service and In-service" was introduced by Mr. George Muito, Unesco consultant.

11. Setting up of the Working Groups

The workshop decided to structure its work by splitting up into three working groups. Each group was to study one point of the agenda and bring the result of its work to the plenary.

Working Group I was to develop strategies to establish environmental education programmes at the national level.

Working Group II was to develop strategies for curriculum development and teaching-learning materials preparation in environmental education for primary and secondary schools and teacher education institutions.

Working Group III was to develop strategies for training teachers in environmental education for primary and secondary schools and teacher education institutions.

The following officers were elected to coordinate the work of each working group :

Group I

Chairman	Rapporteur
Mr. Jean Martin NZAMBA (Gabon)	Mr. Premchand SADDUL (Mauritius

Group II

Chairman	Rapporteur
Mr. David KIYIMBA (Uganda)	Mrs. Bernadette KABRE (Upper Vol

Group III

Chairman
Mr. Alaric N. BOMA (Cameroon)

Rapporteur
Mr. Suleiman FARAH-LODON
(Djibouti)

12. Approval of the Final Report

Based on the reports of individual working groups and the points discussed and further refined during the plenaries, a draft final report was prepared and discussed; it was approved at the last plenary session of the workshop.

13. Closing of the Workshop

The workshop was closed on 20 December 1978. Mr. B. Kamian, Director, BREDA, thanked the participants for their co-operation and good efforts which were essential to the attainment of the goals of the workshop.

The participants expressed their satisfaction with the results obtained during the workshop and thanked Unesco for having made it possible for them to come to the workshop.

General Discussion Report

In the workshop a general discussion followed the country reports and the working papers presented in the plenary sessions. In this discussion the participants considered the items pertinent to the planning and management of environmental education at the national level, curriculum development and preparation of teaching-learning materials, as well as teacher training in environmental education for pre-school, primary, secondary levels and teacher training institutions in the African region.

It was noted that education is a developing process in which philosophies, approaches, methods, curricula and curriculum material undergo a continuous evolution. The constantly increasing knowledge and understanding of the environment, science and technology and the new patterns of human life which they entail make changes in the education of children, youth and indeed adults not only necessary but essential.

Only a few years ago most people in Africa regarded environmental problems as something which only the developed industrialized countries had to contend with. At the time, pollution was associated chiefly with industrial pollution, as the main threat to the environment. The effect of some development projects on the ecological balance were as yet to be widely appreciated.

In his interaction with the environment, man has known a considerable development in his life quality, which has been achieved through a process of social and cultural evolution and advances in science and technology, sometimes leading to environmental degradation.

In recent years, as a result of development at the national and international levels new ideas on the role and objectives of environmental education have emerged. The Intergovernmental Conference on Environmental Education organized by Unesco in cooperation with UNEP at Tbilisi in 1977, the workshop in Belgrade and the expert meetings that took place between 1976 and 1977 in different parts of the world, including the African Regional Meeting of Experts on Environmental Education in Africa (Brazzaville, People's Republic of Congo, 1976), national and sub-regional meetings organized by Member States have made it possible to formulate concepts that give bearings to environmental education as it should be put into practice.

In all these developments it is considered that the ultimate aim of environmental education is to develop a world population that is aware of and concerned about the environment and its associated problems, and which has the knowledge, skills, attitudes, motivation and commitment to work individually and collectively towards solutions of current problems and prevention of new ones.

To achieve the above objectives, environmental education should consider the environment in its totality - natural and man-made, ecological, political, economic, technological, social, legislative, cultural and aesthetic.

Being an integral part of the education process, environmental education is not just one more subject to be added to existing programmes but should be incorporated into the programmes intended for all learners whatever their age. A new joint pattern of work must be drawn up, involving home, community and school, to introduce young people to environmental issues. Environmental education should serve as a catalyst or common denominator in the renewal of contemporary education. Clear and functional relationships must be established and maintained between needs, goals, objectives, the curriculum and evaluation methods to orient learners toward a solution of the problems of the environment or at least to better equip them in this regard.

• Planning and Management of Environmental Education at the National Level

Many countries in the region recognize that there can be no hope of finding viable solutions to environmental problems unless and until education at all levels is also suitably modified to enable people from all walks of life to comprehend, from childhood onwards, the fundamental interactions and inter-relationships between humans and their environment. To facilitate this, alternative planning and management of environmental education at the national level must be developed.

It was clear from the national reports presented by the participants that in spite of the problems encountered in understanding the concept of environmental education and the lack of resources to develop environmental education programmes, a number of countries in the region have made some advances in developing and implementing environmental policy at the national level.

Environmental education topics have been introduced in education in the formal (pre-primary, secondary and university) and non-formal education for youth, adults and the general public. At the primary education level, environmental education topics of relevance to the immediate environment have been introduced to provide supplementary educational resources. At the university level, efforts have been made to introduce environmental topics through interdisciplinary courses. Environmental problems are considered to a lesser extent in some subjects at the secondary school level, e.g., Social Studies, Environmental Studies, or single subject areas.

Different programmes for the general public and out-of-school youth and young adults centered on the environment have been developed. In many cases, the developments in environmental education have been accompanied by the establishment of new institutional arrangements for environmental education in different countries. For the formal sector, programmes have either been developed or work is underway to introduce environmental components into the teaching of traditional subjects in the schools, and curriculum units and teaching materials in environmental education are being prepared for particular environmental issues relating to rural and urban life. Some examples of establishment of strategies and institutions to spearhead developments in planning and management processes in environmental education are the setting up of National Environmental Institutes, Secretariats and Councils, Agricultural Youth Centres in Mauritius, Youth Camps, the Day of the Tree Programmes, Curriculum Development Centres, in Senegal, Central African Republic, Kenya, Gabon, Togo, Guinea Bissau, Uganda, etc. At the higher education levels in many countries, special courses, seminars and training sessions on environmental education topics have been conducted. In some countries, at universities and institutes, special faculties, institutes, or programmes for environmental studies have been established. Some of the examples of these are the Institute of Environment at the University of Dakar, Senegal, the Department of Environmental Studies at Kenyatta University College, and environmental education courses in departments of engineering architecture, design, town planning, agriculture and education.

It was also observed, however, that although programmes and institutions have been set up, there are many problems to be overcome before environmental education becomes a reality in the region.

In keeping with the nature of environmental education, some extra-curricular or informal activities emphasizing participation and stimulating initiatives have been undertaken in a number of countries. These include excursions, study tours, and field studies, along with many other activities carried out by youth associations, clubs and political movements. Youth have been involved in health and other self-help campaigns in some countries in the region.

Youth camps have been organized. Travelling exhibitions, competitions, lectures on environmental topics have been used in order to increase environmental consciousness. Mass media, radio, television, films and the press have played a very important role in many countries for the dissemination of environmental information. Publications have popularized recent scientific findings and environmental field days have been held. In certain cases, councils for environmental education have been set up. Environmental education programmes may not always be conducted exclusively by ministries of education but also by ministries which are concerned with environmental problems such as ministries of health, agriculture, land and mines, community development, and where it applies, by those ministries that have special responsibility for the environment.

Effective implementation of environmental education calls for the development of appropriate teacher training programmes. This requires the articulation of the required competencies - regarding knowledge, attitudes and skills; the identification of target populations for the training, both pre-service and in-service, of teachers of environmental education; teachers of other subjects, teacher trainers and educational administrators; assessment of related concepts and programmes; assessment of research, experiences, models and materials useful to environmental education, and the use of local environment and community as a learning resource for environmental education.

Preliminary discussions on the planning and management of environmental education stressed the following points :

The participants stressed that the planning and administration of environmental education were components of education planning which in its turn is a component of the national development plan.

Planing must take into account the political, economic, cultural and educational structures of each country. Therefore, the problem will be to assess the needs, priorities and objectives of the programmes as well as evaluation methods.

It is therefore important that consideration be given to planning, administration, evaluation of environmental education, in order to ensure an effective coordination of programmes in environmental education.

It is also necessary to provide the financial resources necessary for implementing these programmes.

The promotion of research in environmental education is an important component in the development and implementation of environmental education because it develops new strategies in environmental education and provides for continuous evaluation.

Any coherent planning must define short and long term objectives and activities and should also identify the different stages of planning and implementation of the programmes.

(a) The first stage is for starting activities. At this stage, a starting group composed of experts in charge of collecting data and information necessary in the plan development processes should be formed where it already does not exist.

(b) The second stage involves planning and developing activities.

(c) The third stage is the implementation stage for the foreseen activities. Participants insisted here on the need for coherence and coordination of undertaken actions, in order to avoid scattering and wasting the scarce resources.

Finally, in the implementation of environmental education, evaluation is essential. Stock of the situation must be taken in order to determine the achievements and the failures.

2. Curriculum Development and Preparation of Teaching-Learning Materials in Environmental Education

Since the ultimate aim of environmental education is to enable people to understand the complexities of the environment and the need for nations to adopt their developmental activities in ways which are harmonious with the environment, a new dimension to the efforts made everywhere must be added to improve living conditions. Environmental education must also help to create an awareness of the economic, political and ecological interdependence of the modern world so as to enhance a spirit of responsibility and solidarity among nations. This is a prerequisite for solving serious environmental problems at the global level, as for example those relating to oceans or to the contamination of the atmosphere.

However, the major problems remain those familiar to the learners in their own home, community and nation and who should help the learners to acquire the knowledge, values and skills necessary to help solve those problems. This means that environmental education involves learning from the environment as well as about the environment, and in many situations this would require changes to be made in some established approaches to teaching, especially in formal education. With the adoption of this problem-oriented and action-oriented approach, environmental education thereby becomes both lifelong and forward looking. By its interdisciplinary nature, as well as by bringing education nearer to the environment and to life, environmental education can play a considerable role in the renovation of education systems.

The content selected, techniques, methods and materials developed for environmental education must be adapted to the needs of the learners.

Distinctions must be made, in the role of environmental education, in curriculum development for increased awareness and understanding of environmental problems among the general public (children, youth and adults); for preparing occupational groups whose responsibilities bear directly on environmental problems and opportunities, for example, engineers, planners, architects, medical personnel, teachers, administrato industrial managers and for training specialists for research or other work relating to the environmental sciences. There is a considerable need for innovation to approaches and methods for all of those levels and types of environmental education, and for the exchange of information and experience within and among countries.

In recent years, some efforts to foster the development of environmental education have been made. Different strategies have been used in these efforts. Some of these are the inclusion of environmental topics in education, training of personnel required for the development of environmental education, development of teaching-learning materials, and research at the national level for environmental education.

Some examples of curriculum programmes developed in the African region in this period are primary environmental science courses, and environmental studies incorporated to various subjects in social studies, national and sub-regional education programmes.

The participants considered the role of examinations and evaluation. The workshop emphasized the need to develop appropriate evaluation, which would continually give information on needs of curriculum developers The need to develop appropriate examination techniques was also emphasized. Finally, there is a need for developing or defining overall strategies which will define and develop the objectives, content, methods and modalities of school and out-of-school environmental education at different levels and for different groups.

It has proved necessary to evaluate the general scope of environmental education, its general goals and its specific objectives which the guiding principles should therefore define. These should take into account the needs of the society, the psycho-motor, affective and intellectual needs of the pupils and the subject matter to be covered.

Programmes should be developed as much as possible in relation to environmental education themes and according to urgent issues and priorities as nature preservation, family, diseases, housing, etc...

Contents, methods and teaching-learning materials should be developed for the different levels.

At the Pre-primary level : The child must be sensitized, its curiosity must be fostered, and also be taught to benefit from its immediate environment through such activities as excursions, poetry and song which will contribute to the understanding of the environment.

At the Primary level : Manual, intellectual and artistic activities, visits related to environmental education should be organized to enable the pupils to structure their knowledge of the environment and to adopt positive attitudes.

At the Secondary level : Environmental education will benefit from the excursions, games and practicals : school gardens, animal husbandry, laboratories, visits, games, etc. that will contribute to giving the pupils an overall view of the environment.

Teacher Training Institutions : To lectures will be added manual activities on their immediate environment, the marking of micro-plots, analysis of the area surface features, concrete animal and plant study, analysis and recording of collected data.

As for teaching-learning materials, their conception and development imply the type of evaluation which enables them to be tried out. These materials need to be tried out before they can be released for general dissemination, so as to ensure that they are suitable for adaptation. The instructional materials may be printed as illustrated booklets, audio-visual materials, films, etc...

The success of curriculum development and preparation of teaching-learning materials implementation depends on the organization and coordination among administrative and ministerial bodies and on adequate teacher training at all levels (pre-primary, primary, secondary and teacher training institutions).

3. Teacher Training for Environmental Education

The process of education depends on many factors : curricula, instructional materials, functional audio-visual aids, school facilities and so on. Most important of all are the teachers who translate the curricula into learning opportunities, the teachers who interpret the curricula and continually try to achieve the goals set out in the curricula.

During the past two decades of intense curriculum development in Africa it has become increasingly apparent that no instructional materials are "teacher proof". The curriculum developers can conceive and create materials which should be able to enable the learner to achieve almost any goal. However, when placed in the hands of teachers, the materials often get used in ways and towards achieving objectives other than those originally intended by the developers of the curricula. Thus, the role of the teacher in making use of curricula, the different facilities in the school and above all in influencing the behaviour of students as he helps them to develop an understanding, attitudes and skills cannot be underestimated, hence the importance of effective teacher education.

In discussing teacher training for environmental education, the participants felt that education in several African countries has been environmental at least as far as the primary education is concerned, in the sense that it is related to a study of nature and explores the man and society relationship. A large number of primary school teachers are nevertheless untrained and inexperienced and consequently lack the expertise necessary for organizing activities in environmental education. As a result, the methodology used is insufficiently adapted to the needs of the learners.

- At the secondary school level there is also a great shortage of trained and qualified teachers in the field of environmental education. In any case the teacher training institutions for the secondary level seem to have not started teacher training programmes in environmental education.

At the level of university education a small number of institutions, among them Kenyatta University College, Namutamba College (Uganda), Bunumbu Teachers College (Sierra Leone), Institute of Environmental Sciences in the University of Dakar, have developed general environmental curricula for teachers.

The participants felt that while encouraging the many efforts and achievements that were cited in the discussions, there are some gaps and shortcomings that need to be considered in the total development of environmental education. Little coherent work seems to have been done at pre-school, primary and secondary levels, and even at the university level in terms of innovations. Programmes must also be developed for educators of environmental education for non-formal education.

4. Summary

In conclusion, it is necessary to rely on local material and financial resources to meet the requirements in pre-service and in-servic teacher education. It was also suggested that part of the in-service teacher education be done at the expense of the communities. As training for environmental education may be done by career teachers as well as by professionals in other fields, it would certainly call for concerted efforts and closer cooperation among them all.

For the purpose of pre-service and in-service teacher education, participants agreed to first use the existing infrastructure at the national level. It was recognized that regional or international institutions may be needed for training some types of teachers for environmental education. To ensure pre-service education or in-service education, it is necessary to know what type of people are to be trained or retrained. The definition of the profile of candidates for teacher training is therefore an important pre-requisite.

For example, as secondary teacher trainers, students who will be recruited at different university levels must be at least graduates with broad general knowledge.

For in-service teachers, environmental aspects must be introduced in their usual refresher courses, for it may not be possible to organize special refresher courses on environmental education. The lengths of the retraining course should be related to the possibilities of each country. Their rhythm varies at the national level, their frequency can be long; once a year, for instance; but at the local (provincial level) the process must be a continuous one. Further, the training should be organized by competent professionals, such as supervisors, inspectors, curriculum developers, etc.

Curricula and teaching-learning materials should be prepared by trainers and trainees so as to fulfill the expectations of the concerned people and to contribute to the enrichment of their experiences.

Finally, it is important not only to bring the teacher to assume more responsibility, but specially to evaluate his work in relation to the progress made in the field of environmental education.

APPENDIX "I"

TABLES 11 - 15

Table 11: Involvement of students in BLAC activities with this teacher, Other teachers, and Other persons.

ACTIVITY	This T	Other T	Other P*
Collecting and organizing environmental information			
1. Visiting the museum to study biological specimen.	10	06	09
2. Observing the behavior of a specific living thing .	33	55	1
3. Collecting water from a pond/lake/river and observe.	1	29	07
4. Observing breeding grounds of a harmful/useful local insect, (e.g, a housefly, mosquito, tsetse fly, bee, etc.)	20	42	09
5. Bringing some living things to the lab for further study.	19	48	01
6. Explaining behavior of a plant/animal you know well from home, or school .	41	55	22
7. Visiting a school garden or shamba for a biology lesson.	12	31	10
8. Looking at drawings of organisms which are found in Tanzania.	27	37	16
9. Reading a book or paper in order to search information on East African /Tanzanian soils, flora or fauna.	19	29	15
9. Talking or writing about things you do at your home which are of biological interest.	13	20	33
10. Comparing eating habits of your home area and those of your fellow classmates.	1	15	25
11. Finding out traditional methods of doing things e.g preserving food, brewing alcohol, treating diseases, in a local area.	36	36	31
13. Tracing a local food chain around the school or your home area.	21	19	15
14. Observing/discussing any ecological problem around the school/village e.g, shortage of firewood, making of charcoal, soil erosion, etc.	30	49	18
15. Observing/discussing how the school handles refuse /garbage.	12	1	08
16. Visiting the local hospital/health centre to study something.	08	07	09
17. Dissecting or observing the inside of a dissected animal.	17	13	02
18. Observing microorganisms e.g, yeast, fungi, bacteria under the microscope.	15	33	01
19. Doing simple chemical tests on local foods like cassava /maize	15	37	1
20. Listening to a local expert (from the university, research institute, hospital etc.) speak about biological issues.	07	1	16
Generating new information from previous environmental experiences			
21. Identifying living things around the school compound.	38	65	10
22. Drawing/labelling living things in their natural habitat.	37	72	09
23. Drawing/labelling preserved specimen in the lab. or class.	31	39	01
24. Generating local names of plants/animals around the school.	30	33	08
25. Working with a biological model, e.g, of the heart, skeleton, etc.	54	22	03
26. Studying a film/slides discussing/showing any biological phenomena.	1	07	07
27. Devising methods of solving an ecological problem.	09	12	07
28. Studying any current biological problem around your school or home and			

write a report.	12	16	05
29. Comparing some traditional ways of explaining biological observations and arriving at conclusions to the scientific way of explaining those observations.	10	12	08
30. Reading about organisms living in other parts of the world.	23	31	20
Communicating environmental information			
31. Discussing how animal or human sewage is dealt with in a village or towns.	18	27	20
32. Giving a local explanation of any biological phenomena.	18	27	18
33. Finding ways of saving a decaying environment (e.g, forest, lake, sea).	21	40	18
34. Discussing any controversial environmental issue facing your school or country in groups and develop ways to make an informed assessment of the consequences of a proposed decision	08	08	10
35. Discussing the interrelationships of the animals in any Tanzanian Game park.	01	13	12
36. Making or discussing a list of the animals in danger of extinction.	06	15	15
37. Discussing local causes of pollution in Tanzania or Africa in general.	07	16	12
38 Discussing relevance of recent discoveries in East Africa e.g, the use of *Crotalaria ochreleuca* (marejea) or *Azolla* in improving soil fertility, or the use of the improved charcoal stove and other devices to save charcoal when cooking.	06	16	10
39. Discussing how pollution has endangered life forms in some parts of the world.	09	12	09
40. Comparing traditional and modern methods of preventing soil erosion.	22	33	09
41. Participating in solving a problem facing your community environment, e.g cleaning part of the city, planting trees, putting terraces on farms.	19	35	20
Evaluating environmental information			
42. Examining the adequacy of data, and validity of conclusions from a book, newspaper, or local story discussing a biological problem	08	09	12
43. Doing a project on the biology of an important organism found in Tanzania.	04	09	06
44. Looking for authority /assumptions underlying a certain biological phenomena.	07	07	06
45. Using your knowledge of other subjects (e.g, chemistry, geography, physics etc. in addressing a biological problem.	27	33	14

( ) Present T= Present teacher

Other T = Other Teacher (e.g in previous classes, or subjects other than Biology)

Other P = Other person- including parents, siblings, peers, etc.

Numbers indicate % of students in the overall sample (N=99).

Table 12: Students involvement with activities in BLAC instrument with their respective teachers.

ACTIVITY	% Students recalling doing activity with this teacher			
	T1	T2	T3	T4
Collecting and organizing environmental information				
1. Visiting the museum to study biological specimen.	10	06	13	09
2. Observing the behavior of a specific living thing .	17	41	33	48
3 Collecting water from a pond/lake/river and observe.	0	06	23	13
4. Observing breeding grounds of a harmful/useful local insect, (e.g, a housefly, mosquito, tsetse fly, bee, etc.)	03	41	23	22
5. Bringing some living things to the lab for further study.	0	18	43	,13
6. Visiting a school garden or shamba for a biology lesson.	0	0	33	09
7. Looking at drawings of organisms which are found in Tanzania.	10	24	47	26
8. Reading a book or paper in order to search information on East African /Tanzanian soils, flora or fauna.	10	0	43	13
9. Finding out traditional methods of doing things e.g preserving food, brewing alcohol, treating diseases, in a local area.	38	59	40	13
10. Tracing a local food chain around the school or your home area.	03	53	23	17
11. Observing/discussing any ecological problem around the school/ village e.g, shortage of firewood, making of charcoal, soil erosion, &c.	07	35	47	35
12. Observing/discussing how the school handles refuse /garbage.	0	12	33	0
13. Visiting the local hospital/health centre to study something.	0	0	07	0
14. Dissecting or observing the inside of a dissected animal.	14	0	10	0
15. Observing microorganisms e.g, yeast, fungi, bacteria under the microscope.	03	06	37	09
16. Doing simple chemical tests on local foods like cassava /maize.	03	18	33	04
17. Listening to a local expert (from the university, research institute, hospital etc.) speak about biological issues.	03	0	20	0
Communicating environmental information				
18. Explaining behavior of a plant/animal you know well from home, or school .	14	65	47	52
19. Talking or writing about things you do at your home which are of biological interest.	10	06	23	09
20. Comparing eating habits of your home area and those of your fellow classmates.	0	18	23	04
21. Discussing how animal or human sewage is dealt with in a village or towns.	07	214	33	09
22. Giving a local explanation of any biological phenomena.	07	12	30	22
23. Finding ways of saving a decaying environment (e.g, forest, lake, sea).	07	24	0	13
24. Discussing any controversial environmental issue facing your				

school or country in groups and develop ways to make an informed assessment of the consequences of a proposed decision.	14	06	07	04
25. Discussing the interrelationships of the animals in any Tanzanian Game park	0	0	03	0
26. Making or discussing a list of the animals in danger of extinction.	0	06	17	0
27. Discussing local causes of pollution in Tanzania or Africa in general.	03	0	20	0
28 Discussing relevance of recent discoveries in East Africa e.g, the use of *Crotalaria ochreleuca* (marejea) or *Azolla* in improving soil fertility, or the use of the improved charcoal stove and other devices to save charcoal when cooking.	07	0	13	0
29. Discussing how pollution has endangered life forms in some parts of the world.	03	0	20	09
30. Comparing traditional and modern methods of preventing soil erosion.	03	47	30	17
31. Participating in solving a problem facing your community environment, e.g cleaning part of the city, planting trees, putting terraces on farms.	24	12	27	09

Generating new information from previoud environmental experiences.

32. Identifying living things around the school compound.	14	65	57	26
33. Drawing/labelling living things in their natural habitat.	07	71	50	35
34. Drawing/labelling preserved specimen in the lab. or class.	24	47	30	30
35. Generating local names of plants/animals around the school.	07	35	50	30
36. Working with a biological model, e.g, of the heart, skeleton, etc.	55	29	50	73
37. Studying a film/slides discussing/showing any biological phenomena.	10	06	03	26
38. Devising methods of solving an ecological problem.	03	0	13	17
39. Studying any current biological problem around your school or home and write a report.	07	12	23	04
40. Reading about organisms living in other parts of the world.	21	24	30	17

Evaluating environmental information

41. Examining the adequacy of data, and validity of conclusions from a book, newspaper, or local story discussing a biological problem.	03	12	13	04
42. Doing a project on the biology of an important organism found in Tanzania.	07	0	07	0
43. Comparing some traditional ways of explaining biological observations and arriving at conclusions to the scientific way of explaining those observations.	14	06	13	04
44. Looking for authority /assumptions underlying a certain biological phenomena.	0	06	10	13
45. Using your knowledge of other subjects (e.g, chemistry, geography, physics etc.in addressing a biological problem.	28	29	33	17

( ) T1= Mrs. Maganga

T2= Mr. Mifano

T3= Mrs. Chapuchapu

T4= Mr. Moyo

Numbers indicate % in each class for each category.

Table 13: Students' perceptions of the relative involvement of other teachers in promoting particular biology learning activities.

ACTIVITY	% of students from each class			
	CT1	CT2	CT3	CT4(***)
Collecting and organizing environmental information				
1. Visiting the museum to study biological specimen.	07	0	10	04
2. Observing the behavior of a specific living thing .	59	06	80	
3.Collecting water from a pond/lake/river and observe.	35	06	35	07
4. Observing breeding grounds of a harmful/useful local insect, (e.g, a housefly, mosquito, tsetse fly, bee, etc.)	66	06	47	35
5. Bringing some living things to the lab for further study.	35	06	3	61
6. Visiting a school garden or shamba for a biology lesson.	28	12	27	57
7. Looking at drawings of organisms which are found in Tanzania.	48	24	43	26
8. Reading a book or paper in order to search information on East African /Tanzanian soils, flora or fauna.	38	0	33	35
9. Finding out traditional methods of doing things e.g preserving food, brewing alcohol, treating diseases, in a local area.	41	12	40	44
10. Tracing a local food chain around the school or your home area.				
11. Observing/discussing any ecological problem around the school/village e.g, shortage of firewood, making of charcoal, soil erosion, etc.	65	0	60	48
12. Observing/discussing how the school handles refuse /garbage.	03	06	13	22
13. Visiting the local hospital/health centre to study something.	0	0	13	13
14. Dissecting or observing the inside of a dissected animal.	10	0	3	13
15. Observing microorganisms e.g, yeast, fungi, bacteria under the microscope.	31	0	67	17
16. Doing simple chemical tests on local foods like cassava /maize.	35	06	47	52
17. Listening to a local expert (from the university, research institute, hospital etc.) speak about biological issues.	07	12	13	01
Communicating environmental information				
18. Explaining behavior of a plant/animal you know well from home, or school .	52	47	67	48
19. Talking or writing about things you do at your home which are of biological interest.	35	06	20	13
20. Comparing eating habits of your home area and those of your fellow classmates.	21	06	20	09
21. Discussing how animal or human sewage is dealt with in a village or towns.	45	0	37	13
22. Giving a local explanation of any biological phenomena.	41	06	40	09
23. Finding ways of saving a decaying environment				

(e.g. forest, lake, sea).	52	0	43	8
24. Discussing any controversial environmental issue facing your school or country in groups and develop ways to make an informed assessment of the consequences of a proposed decision.	0	06	07	09
25. Discussing the interrelationships of the animals in any Tanzanian Game park.	21	06	10	13
26. Making or discussing a list of the animals in danger of extinction.	28	0	13	13
27. Discussing local causes of pollution in Tanzania or Africa in general.	24	06	20	09
28 Discussing relevance of recent discoveries in East Africa e.g. the use of *Crotalaria ochreleuca* (Sw.marejea) or *Azolla* in improving soil fertility, or the use of the improved charcoal stove and other devices to save charcoal when cooking.	10	06	13	09
29. Discussing how pollution has endangered life forms in some parts of the world.	10	0	20	13
30. Comparing traditional and modern methods of preventing soil erosion.	45	06	40	30
31. Participating in solving a problem facing your community environment, e.g cleaning part of the city, planting trees, putting terraces on farms.	41	06	43	39
Generating new knowldge from previous environmental experiences				
32. Identifying living things around the school compound.	90	18	67	70
33. Drawing/labelling living things in their natural habitat.	90	18	83	78
34. Drawing/labelling preserved specimen in the lab. or class.	45	06	67	22
35. Generating local names of plants/animals around the school.	31	0	53	35
36. Working with a biological model, e.g, of the heart, skeleton, etc.	28	0	30	21
37. Studying a film/slides discussing/showing any biological phenomena.	03	0	10	13
38. Devising methods of solving an ecological problem.	17	06	10	13
39. Studying any current biological problem around your school or home and writing a report.	14	06	30	09
40. Reading about organisms living in other parts of the world.	49	0	40	22
Evaluating environmental information				
41. Examining the adequacy of data, and validity of conclusions from a book, newspaper, or local story discussing a biological problem.	0	06	07	13
42. Doing a project on the biology of an important organism found in Tanzania.	14	0	10	09
43. Comparing some traditional ways of explaining biological observations and arriving at conclusions to the scientific way of explaining those observations.	24	0	13	04
44. Looking for authority /assumptions underlying a certain biological phenomena.	03	0	10	13
45. Using your knowledge of other subjects (e.g, chemistry, geography, physics etc. in addressing a biological problem.	48	06	37	30

***

CT1= Class of Mrs. Maganga(School A)

CT3= Class of Mrs. Chapuchapu(School B)

CT2= CLass of Mr. Mifano(School A)

CT4= Clas of Mr. Moyo(School C)

Table 14: Students' learning experiences from non formal sources versus fathers' occupation.

ACTIVITY	% Overall fathers occupation (****)				
	O1	O2	O3	O4	O5
Collecting and organizing environmental information					
1. Visiting the museum to study biological specimen.	16	04	0	04	18
2. Observing the behavior of a specific living thing .	16	1	0	1	0
3. Collecting water from a pond/lake/river and observe.	06	07	0	1	0
4. Observing breeding grounds of a harmful/useful local insect, (e.g, a housefly, mosquito, tsetse fly, bee, etc.)	09	14	0	04	09
5. Bringing some living things to the lab for further study.	0	0	0	0	0
6. Visiting a school garden or shamba for a biology lesson.	16	04	0	07	18
7. Looking at drawings of organisms which are found in Tanzania.	16	14	0	15	27
8. Reading a book or paper in order to search information on East African /Tanzanian soils, flora or fauna.	28	1	0	0	27
9. Finding out traditional methods of doing things e.g preserving food, brewing alcohol, treating diseases, in a local area.	44	32	0	22	18
10. Tracing a local food chain around the school or your home area.	25	14	0	1	0
11. Observing/discussing any ecological problem around the school/village e.g, shortage of firewood, making of charcoal, soil erosion, etc.	24	14	0	19	09
12. Observing/discussing how the school handles refuse /garbage.	16	0	0	07	09
13. Visiting the local hospital/health centre to study something.	13	04	0	04	27
14. Dissecting or observing the inside of a dissected animal.	06	0	0	0	0
15. Observing microorganisms e.g, yeast, fungi, bacteria under the microscope.03	0	0	0	0	
16. Doing simple chemical tests on local foods like cassava /maize.	25	07	0	0	09
17. Listening to a local expert (from the university, research institute, hospital etc.) speak about biological issues.	25	1	0	1	18
Communicating environmental information					
18. Explaining behavior of a plant/animal you know well from home, or school .	34	21	0	1	18
19. Talking or writing about things you do at your home which are of biological interest.	50	21	0	22	46
20. Comparing eating habits of your home area and those of your fellow classmates.	34	14	0	26	27
22. Discussing how animal or human sewage is dealt with in a village					

or towns.	28	07	0	22	27
21. Giving a local explanation of any biological phenomena.	22	14	0	15	27
23. Finding ways of saving a decaying environment (e.g, forest, lake, sea).	34	14	0	15	09
24. Discussing any controversial environmental issue facing your school or country in groups and develop ways to make an informed assessment of the consequences of a proposed decision.	19	07	0	14	09
25. Discussing the interrelationships of the animals in any Tanzanian Game park.	19	1	0	07	09
26. Making or discussing a list of the animals in danger of extinction.	31	07	0	1	0
27. Discussing local causes of pollution in Tanzania or Africa in general.	16	1	0	15	0
28 Discussing relevance of recent discoveries in East Africa e.g, the use of *Crotalaria ochreleuca* (Sw.marejea) or *Azolla* in improving soil fertility, or the use of the improved charcoal stove and other devices to save charcoal when cooking.	13	0	0	19	09
29. Discussing how pollution has endangered life forms in some parts of the world.	13	1	0	07	0
30. Comparing traditional and modern methods of preventing soil erosion.	16	07	0	07	0
31. Participating in solving a problem facing your community environment, e.g cleaning part of the city, planting trees, putting terraces on farms.	31	14	0	15	18

Generating new information from environmental experiences

32. Identifying living things around the school compound.	19	10	0	04	0
33. Drawing/labelling living things in their natural habitat.	19	07	0	04	0
34. Drawing/labelling preserved specimen in the lab. or class.	0	0	0	0	09
35. Generating local names of plants/animals around the school.	06	07	0	1	09
36. Working with a biological model, e.g, of the heart, skeleton, etc.	09	0	0	0	0
37. Studying a film/slides discussing/showing any biological phenomena.	16	04	0	04	0
38. Devising methods of solving an ecological problem.	13	07	0	04	0
39. Studying any current biological problem around your school or home and write a report.	13	04	0	0	0
40. Reading about organisms living in other parts of the world.	34	25	0	04	09

Evaluating environmental information.

41. Examining the adequacy of data, and validity of conclusions from a book, newspaper, or local story discussing a biological problem.	28	1	0	0	0
42. Doing a project on the biology of an important organism found in Tanzania.	13	04	0	04	0
43. Comparing some traditional ways of explaining biological observations and arriving at conclusions to the scientific way of explaining those observations.	13	1	0	0	09
44. Looking for authority /assumptions underlying a certain biological phenomena.	16	0	0	04	0
45. Using your knowledge of other subjects (e.g, chemistry,					

geography, physics etc. in addressing a biological problem.	19	14	0	07	18

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(   )parental occupation (Fathers job):

O1= Professional parents e.g doctors, lawyers,et cetera.

O2= Semi-professional parents, Secretarial workers, nurses, et cetera.

O3=Peasants/farmers

O4=Unemployed
O5=Others

Table 15: List of Selected UNESCO-UNEP Publications Relevant for Environmental Education at Secondary Schools Level.

No.	Title	Year
1.	ırends in Environental Education E since the Tbilisi Conference	1983
2.	Guide on Gaming and Simulation for EE	1983
3.	Educational Module on Environmental Problems in Cities	1983
4.	EE Module for Pre-Service training of Science Teachers and Supervisors for Primary Schools	1983
5.	EE Module for In-Service Training of Science Teachers and Supervisors for Secondary Schools	1983
6.	EE Module for Pre-Service Training of Social Science Teachers and Supervisors for Secondary Schools	1985
7.	EE Module for In- Service Training of Social Science Teachers and Supervisors for Secondary Schools.	1985
8.	Guide on EE Evaluation at School	1985
9.	Interdisciplinary Approaches in EE	1985
10.	A problem Solving Approach to EE	1985
11.	Environmental Education Module on desertification	1985
12.	A Comparative Survey of the Incorporation of Eniromental Education in School Curricula	1985
13.	The Balance of "Lifekind": An Introduction to the Human Environment	1985
14.	Analysis of Results of EE Pilot Projects	1985
15.	EE: Principles of Teaching and Learning	1985
16.	EE Module on Health, Nutrition and the Environment	1985
17.	Procedures for Developing an EE Curriculum	1986
18.	Guidelines for Developing Non Formal EE	1986
19.	EE In Technical and Vocational Education	1986
20.	Strategies For training of Teachers in EE	1987
21.	EE: A Process for Pre-service eacher Training Curriculum development	1988
22.	Prototype EE Curriculum for the middle School	1989
23.	Special Issue- Harvesting One Hundredfold Key concepts and case Studies in EE	1989

Source: United Nations Environment Program, Nairobi, 1990.